ELECTRICAL REVIEW

Managing Editor: HUGH S. POCOCK, M.I.E.E.
General Editor: J. H. COSENS
Technical Editor: P. W. TUCKER, M.I.E.E.

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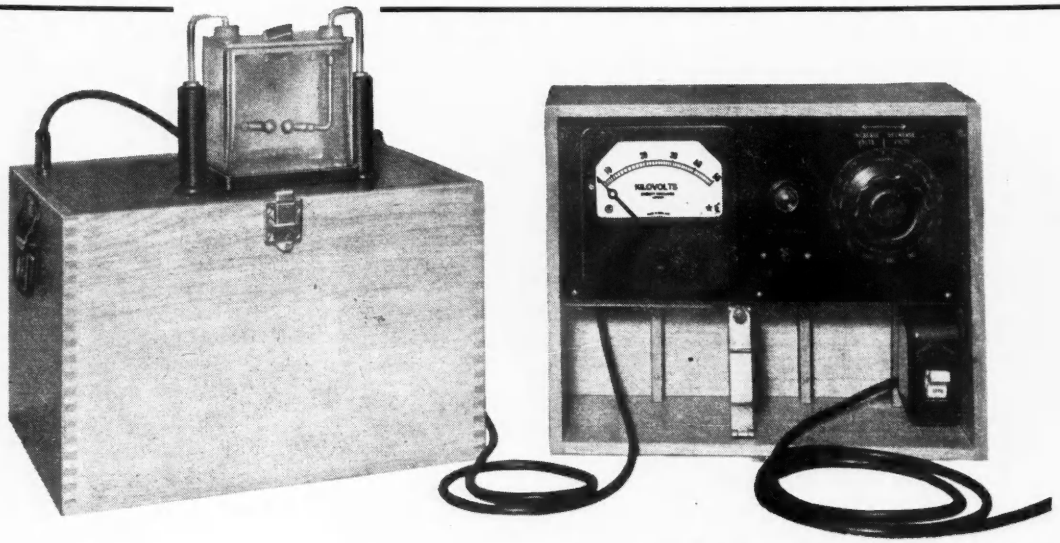

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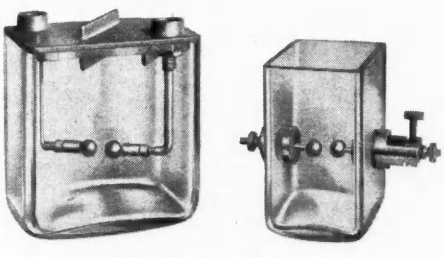

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ELECTRICAL REVIEW

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"Atomic" Electricity

As we see it, the keynote of the article on this subject by Dr. S. G. Bauer in this issue is a warning that the availability of electricity produced by means of nuclear fission is not a problem which has already been solved fully and that many years may have to pass before generation from atomic energy is on as sound a basis as generation from coal. It is beyond doubt that electricity can be produced from atomic energy, but experience in doing so in a practical way is so far negligible.

Dr. Bauer sees the main issues for the present and the years immediately ahead as the provision of exceptional measures against the effects of the highly dangerous radioactive material; a complexity of problems concerned with the transfer of heat from the nuclear reactor to the steam generator, which may well involve a pumping loss of up to 5 per cent of the net electrical output, representing as much as 25 per cent of the reactor heat output at an overall plant efficiency of 20 per cent; and running all this on an economic basis in competition with existing steam plant with exceptionally high capital expenditure on present nuclear energy plant.

These problems will involve special techniques which must be developed progressively with the help of industry, gradually supplementing the work of and taking over the work from the existing Government Department and gradually building up " teams of engineers of all persuasions trained in the scientific principles and technological requirements," all of which must take considerable time to evolve.

The real value of the article is that it puts things in their right perspective against a background of uncertainty and unrealism. For about a lifetime up to soon after the last war when the development of atomic energy first became public knowledge, every branch of the community in this country, including science and industry, particularly the coal and electricity supply industries, was increasingly aware of a certain anxiety regarding future coal supplies in Great Britain because most of the sizeable and hence more profitable coal seams were being used up, leaving only unworked seams so thin that they would be increasingly difficult to work economically.

But there was no sense of crisis about this, and the position was faced with fortitude against a background knowledge that the real answer to the problem rested in materials handling in the pit, which meant more and more mine electrification. Since the development of atomic energy for " peaceful " purposes became feasible, however, and particularly during the past few months, all sorts of statements have been made in political, professional, scientific and academic fields which have created a general impression that atomic energy has come only just in time to save a desperate situation. We believe that Dr. Bauer's article will do much to prevent the unreasonable panic which is likely to arise from such an impression and to bring us back to a field of realism in which we shall visualize coal and atomic energy in competition for a long time, with atomic energy increasingly meeting the power demands of the country.

BRITAIN'S FUEL

In a report, in our last issue, of the presidential address of Dr. W. Idris-Jones to the Institute of Fuel there are some statistics which have a close bearing on and support some of the main contentions expressed in Dr. Bauer's article and in our leading article. Some of these are as follows: the U.S.A. uses 8 tons of coal per person for fuel and power, whereas the comparable figure for Great Britain is 4·5 tons and for the world 1·5 tons. With only one fifteenth of the population of the world and one twentieth of its area, the U.S.A. consumes one third of the total world production of fuel and energy. Dr. Idris-Jones's advice is worth repeating: "The right attitude in regard to our coal reserves is not to spend too much time and energy on calculating how long they will last, but to make the best possible use of the coal we produce. If the need is great enough ways and means will be found for getting and using the vast tonnages of coal which are now considered to be unworkable and unacceptable."

NUCLEAR POWER ENGINEER WANTED

The British Electricity Authority is, of course, very deeply concerned with the possibilities of electricity production from nuclear fission as eventually it will involve radical changes in methods of generation. In preparation for this the Authority is about to set up a new branch in the chief engineer's department which initially will be engaged on design studies of thermal reactors and the conversion of the liberated heat into electricity. Later its functions will include the design, construction and operation of nuclear power stations. As a beginning the Authority is seeking a nuclear power engineer who will be required to organize and lead the new branch. Applicants are expected to be graduates with knowledge of atomic physics, thermodynamics and metallurgy and should preferably be familiar with the design, construction and operational problems of normal thermal power stations. The salary offered (£2,500–£3,000) is such as to attract a good class of man to a position which is the first of its kind in this country and represents the foundation of a new department of electrical power engineering with enormous potentialities.

MINISTERIAL BLESSING

Last year Mr. Geoffrey Lloyd, the Minister of Fuel and Power, announced in the House of Commons that the freedom of the electricity supply and gas industries to carry on development propaganda was to be restored. As a consequence the British Electrical Development Association was able to embark upon the all-out domestic electrification campaign which is now in full swing. At the Association's annual luncheon last week (the resumption of which after last year's break was in itself a sign of manumission) the Minister went even further. He stressed the part which electricity had played in social progress and pictured a very bright electrical future. He took it for granted that electricity was indispensable to industry and stressed the importance of its use in the home to lighten the housewife's burden. Although Mr. Lloyd paid particular attention to cookers and washing machines he no doubt took these merely as two examples of the many domestic applications of electricity. We believe this to be the first occasion on which a Minister of Fuel and Power has expressed himself strongly in favour of domestic electrical development and we are grateful to Mr. Geoffrey Lloyd for his unbiased commendation.

SYMBOLS AND ABBREVIATIONS

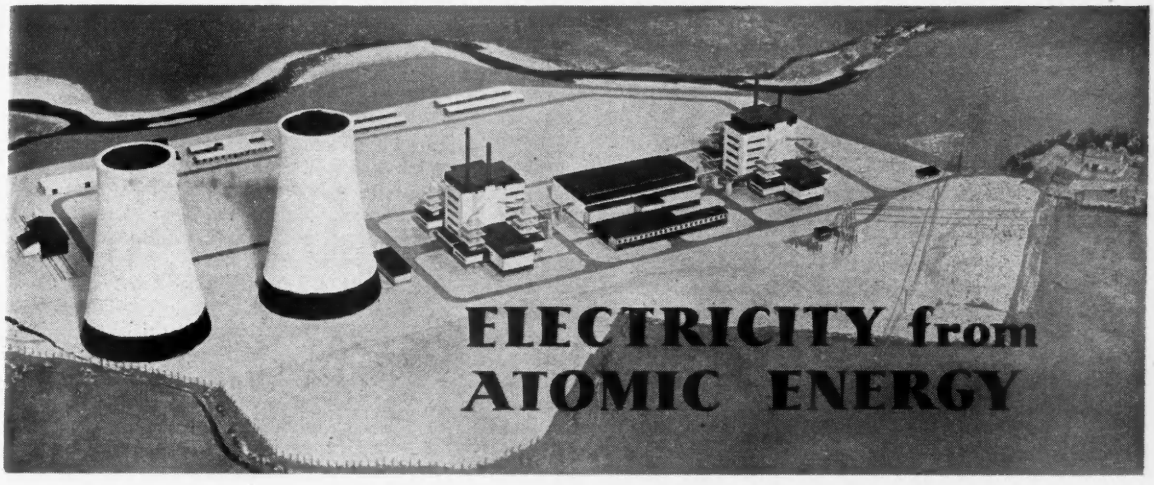
Confusion frequently results from the use by authors of different systems of symbols, signs and abbreviations in similar or related branches of science and technology. To remove unnecessary conflict and to pave the way to the development of a consistent system for the whole scientific field the British Standards Institution has just published B.S. 1991 : 1954, and it will now be left to groups of experts in various specialized fields to build on the foundations thus laid. The attainment of a reasonable measure of agreement will, of course, entail the abandonment of a few practices that are well established in certain fields of work, but taking the broad view, the sacrifice will be well worth making. Departures from well-established usages are recommended, however, only where they are considered to be of serious importance. The recommendations of symbols for thermodynamic quantities should be strictly followed, for these quantities are widely used by workers in practically every branch of science and technology, and incomplete agreement on them has hitherto been one of the major sources of confusion.

E.H.V. WOOD POLE TRANSMISSION

A very big departure from normal electrical engineering practice in this country is represented by the 132 kV transmission line, presumably experimental, which is being erected for the British Electricity Authority between Carmarthen and Haverfordwest in South Wales. The single circuit three-phase line, erected on wood poles, is described in this issue. Savouring somewhat of Continental practice this form of construction is probably the least expensive yet adopted in this country for the normal grid voltage. It will be interesting to learn later about its performance in service and particularly whether the unearthed construction offers any advantages over the normal steel tower type so far as line "outages" are concerned.

Guide to B.I.F.

The British Industries Fair is being held in London and Birmingham from 3rd to 14th May. Next week's issue of "Electrical Review" will contain a complete guide to the electrical exhibits



Model of Britain's first atomic energy power station now under construction (Calder Hall)

Why Does the Development Take so Long?

By Dr. S. G. BAUER*

As long ago as 1940, when the prospect of deriving almost unlimited amounts of energy from the controlled fission disintegration of uranium first became a real possibility, it appeared to those engaged in the subject as though within less than a life-time most coalminers might be put out of work by this revolutionary discovery. Although at the time military possibilities of this new source of energy were of overriding importance, a good deal of thought was given to practical possibilities and ways of carrying them out. In fact, within the first two or three years of the discovery of fission, substantially all the different types of reactors which might be constructed for utilizing atomic energy had been discussed and described in a more or less speculative and rudimentary fashion.

During the war years only a negligible effort could be spared towards the practical development of nuclear power sources; but by the time the war came to a close substantially all the basic knowledge of reactor physics and a lot of technological "know how" had been accumulated and the business of producing useful energy seemed merely a question of getting down to brass tacks without any military distractions and building a first prototype power plant. Moreover, the unprecedented scale and concentration of effort deployed in the United States on the allied atomic energy programme during the war had proved that it was possible to develop and build gigantic and exceedingly intricate plant of an entirely novel kind in an incredibly short space of time.

Clear Perspective Necessary

It was at this psychological moment that the public at large were first informed of the existence and potentialities of atomic energy. Naturally optimism on the subject soared to great heights and with the partial lifting of the complete wartime secrecy there seemed a good prospect of established industry adding its weight to the development and helping to achieve great results in a short space of time. In retrospect we now know that things did not happen in this way and many people are seriously concerned lest the first enthusiasm for atomic energy might have given an altogether false picture. It is still very difficult to see these events in clear perspective, considering the confused political era during which they occurred. This is not the place to go into the details of politics and their ramifications but it is necessary to state two outstanding facts to afford an appreciation of the situation.

During the war years the whole of the allied effort on atomic energy was concentrated in North America, and the United States supplied by far the greatest share of manpower and resources. At the end of hostilities the United States Government imposed a ban on the export of any classified material or information and since all the sources of special atomic energy materials were situated in the United States this country found itself in 1946 with a small nucleus of people with wartime knowledge and experience of various phases of atomic energy work and no physical resources of any kind. On the other side of the picture the United States found itself with vast resources organized for and devoted to military ends. But the power industry in the United States is highly developed, so there was and is no shortage of electricity supplies and very large sources of relatively cheap coal and natural gas are available; hence the incentive there for the exploitation of atomic power is not intrinsically very great and the industrial necessity for atomic energy is really confined to producing power more cheaply than by conventional means and to producing it in places where power is not readily available. Hence the United States has very naturally concentrated on special power units, e.g., for submarines and on long term reactor development which might ultimately lead to competitive economic designs.

In this country again events have followed an inevitable course. First, organizations had to be established on an adequate scale and staff found, assimilated and trained. Then all the basic research and production units had to be built. The story of the various research and

* Dr. Bauer is with the Atomic Energy Research Establishment, Harwell. The views expressed in this article are those of the author and not necessarily those of the Atomic Energy Research Establishment where he is employed.

production atomic energy installations is too well known to need repetition, and the successful tests of atomic bombs in Australia have proved to the world that the breach of 1946 has been made good by creating in this country, in the difficult after-war years, a whole new complex atomic energy industry. So it is only in the last year or two that it has become possible to get some of the crucial materials and to divert some of the available effort to the pressing problem of supplementing this country's energy resources with this new source of power. Even so the first experimental atomic power plant to supply electricity to the grid is under construction at Calder Hall and a further power plant of more complex design is scheduled to be built in the North of Scotland.

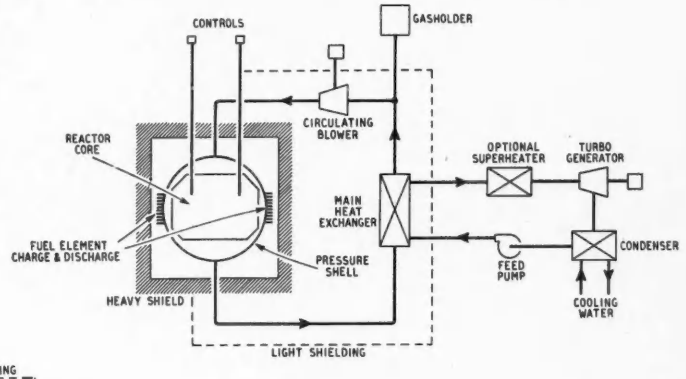
Cost of Atomic Generation

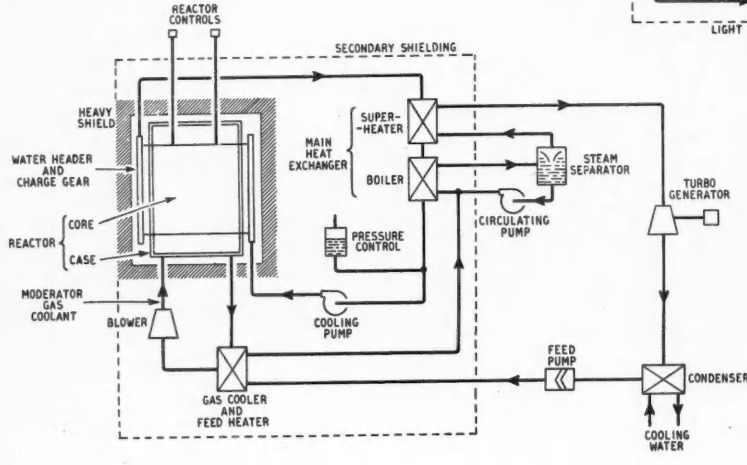
It might well be said that, taking an inside view, there is no cause for complaint. None the less the problem of supplying the ever increasing power demand of this country is so urgent that we must discuss why more cannot be done in a shorter time. To start with, the question of economics has to be accepted with more or less latitude, according to temperament.

It is important to remember that only about one-third of the cost of electricity to the consumer is accounted for by fuel cost, and that the combustion chamber of the boiler and the associated coal and ash handling plants are the only parts of a power station that the heat source called "atomic energy" can replace. So, if atomic energy were to cost nothing at all, electricity would only be some 30 per cent cheaper. Unfortunately atomic plants and all their inevitable paraphernalia are expensive. It is often argued that any new type of plant or process is always expensive at first and that some atomic power plants should be built first, more or less regardless of expense, and that ways of building and operating them more economically would follow naturally. This is, however, not a very sound argument. Nobody will be persuaded to spend several million pounds on an experiment in the mere hope that it will lead to success by spending many more millions. One has to be sure that the enterprise itself will be a success and also that it will lead one further on the most promising lines.

We said earlier on that all the basic possibilities of building power reactors have been known for quite a number of years and that is undoubtedly so. The number of permutations in which the essential elements of a reactor can be put together works out at something over 100. Of these, the combinations which might be practically useful are about 20. When one tries to make the best choice, if indeed there is one best choice, the difficulties begin in earnest. It is, therefore, worth looking in more detail at this problem of choice. If one wished to build a new heavy motor vehicle one would choose in the first place between powering it with a petrol engine or an oil engine. The costs, fuel consumption, maintenance expense and other operating characteristics are known quite accurately, so the choice becomes a simple matter of arithmetic once the duty has been specified. We could now say: Why not drive the thing with a gas turbine or a steam engine? Enthusiasts for either form of prime mover might contend that the operator's needs would be best served by their particular pet engine. The operator or customer would without doubt say that all the arguments brought forward were very convincing and very interesting but in the last analysis only speculative. A lot of money would need to be expended on design and development, and practical experience might prove the protagonists to have been over optimistic.

If we wish to build a nuclear reactor to produce electricity we are in a not dissimilar position. We must have some uranium fuel elements, protected by some kind of sheath, a moderator for slowing down the fission neutrons and a coolant for conveying the heat produced to a prime mover. The moderator could be water, heavy water, beryllium or its oxide, or graphite, and the coolant a gas, water, light or heavy, or a liquid metal like sodium. The dilemma becomes obvious as soon as one attempts to choose some particular combination; wherever one picks on an apparently promising line one finds that an entirely new field of technological development is required before one can set out with any assurance to build a plant or indeed





Above: Gas-cooled reactor circuit

Left: Solid moderator, high-pressure water-cooled reactor circuit

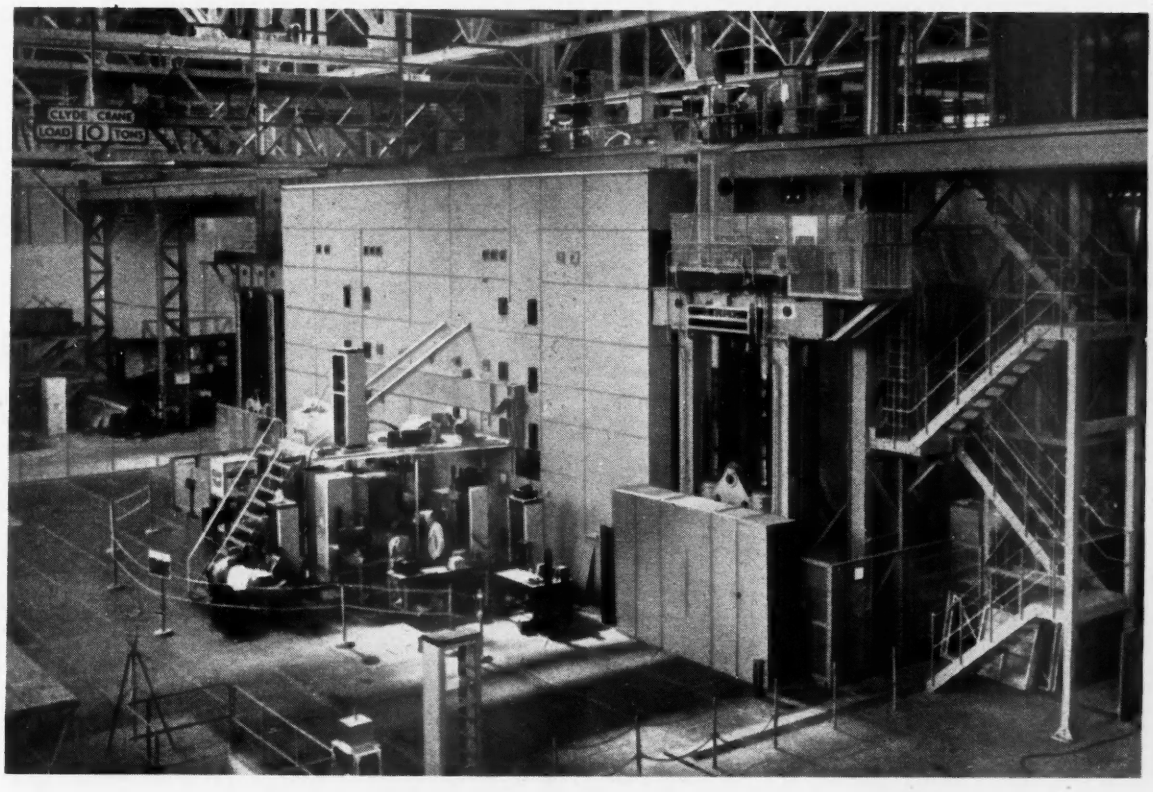
Right: "B.E.P.O." experimental graphite pile at Harwell

to make a reasonable guess at the likely cost of its construction and operation. It is worth going through the specific difficulties of the major reactor combinations at some length because they help to show up the limitations of nuclear power as we can see them to-day. Diagrammatic circuit layouts are given in the accompanying sketches which are not meant to show more than the bare bones of inherently much more complex arrangements.

Since all the reactors in operation in this country at present are gas cooled, it seems reasonable to look first at an adaptation of this type of reactor, which is well understood, to the specific purpose of power production. If we assume a graphite moderated reactor, which is the only practicable one, its core will be very large. It will consist of a cylinder of at least 30 feet diameter, its length pierced by holes containing the uranium fuel elements spaced at something like 8 inches from each other. The cooling gas is blown through these holes to carry the heat produced in the fuel rods to a heat exchanger where steam may be raised. The uranium must be used in discrete units properly spaced for nuclear physical reasons and the available surface area for heat transfer is therefore inevitably limited. The length of the cooling channels and the need to get high heat transfer coefficients involve a substantial pressure drop which has to be paid for in pumping power for the circulating coolant. This is a serious matter since, say, a pumping loss of 5 per cent of the net electrical output of the plant would represent 25 per cent of the reactor heat output at an overall plant efficiency of 20 per cent. True, this power reappears as heat of friction and compression, but it is again only utilized at the expense of the thermal efficiency of the plant. The only major way of dealing with this difficulty is to operate the cooling circuit under pressure. This reduces pumping loss and size of pumping machinery and ducting, as well as reducing the cross-section of the cooling channels in the reactor core which involve a nuclear loss. In principle the coolant could be carried through the reactor in pressure tubes surrounding the fuel channels, thus leaving the moderator under atmospheric pressure. In practice, however, there is no material available for such tubes which has sufficient strength without absorbing too many neutrons. So one has to fall back on the alternative solution of putting the whole reactor in a pressure shell. This shell is obviously very large, and in addition it has to be pierced by large gas duct connections as well as by a large number of holes for fuel handling and control devices. Thus the possible operating pressures are severely limited.

Heat Transfer Problems

The fuel elements themselves have to be provided with appropriate extended surfaces to get as much heat as possible out of them. Extended surfaces, to be useful at high heat ratings, have to be made of a material of high thermal conductivity. At the same time this material must not absorb too many neutrons. Aluminium is just about the only commercially available material which will meet these conditions. High heat ratings mean high temperature differences with the rather low heat transfer coefficients available with gases. So it will be clear that with these physical and metallurgical limitations it is very difficult to push gas outlet temperatures up to anything like the temperatures customary in modern steam plant. Even so, after a great deal of theoretical and experimental work on these specialized heat transfer and metallurgical problems it is possible to raise steam of feasible if not very advanced steam conditions and drive a turbo-generator. As an alternative all the reactor heat might be used to evaporate water, while the superheat was supplied by a conventional fired superheater. This combination, though not 100 per cent atomic, may be economically sound. The greatest merit of this type of reactor



is that it requires no major innovations in or departures from standard engineering practice. For this reason such a plant is not likely to be excessively expensive and it should therefore be able to compete well with more difficult schemes in spite of its inherently low thermal efficiency.

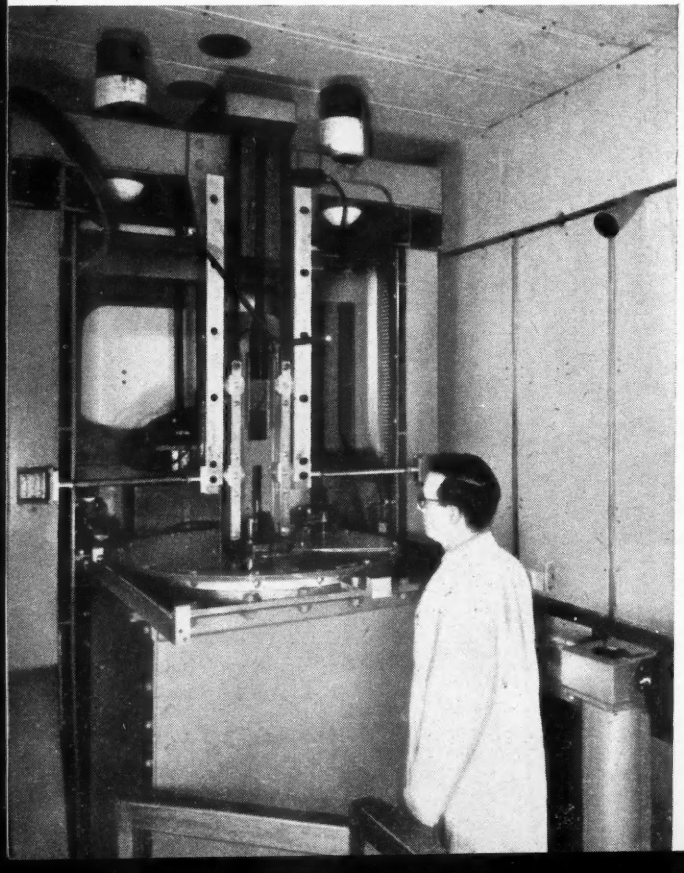
Liquid Cooling

A major alternative to gas cooling, and one which comes readily to mind, is water cooling. As mentioned earlier there is a choice of ordinary or heavy water. The precise details of the choice between the two involves somewhat recondite nuclear physics arguments. But the main point is that a heavy water reactor can be made to operate with natural uranium in the first instance while a natural water reactor requires uranium slightly enriched in its fissile isotope U235. Thus in the first place the cost of heavy water which is of the order of £50,000 per ton has to be balanced against the cost of enriched uranium. Then various technical differences have to be taken into account. The correct array of fuel rods in heavy water requires something of the order of one-inch diameter rods spaced six or eight inches apart. Such an array will make a reactor of critical size in a tank of about 10ft linear dimensions. To make it much bigger would involve an inordinate amount of heavy water which is not only expensive but also only available in limited quantities. As a result the unit heavy water reactor contains only a small tonnage of uranium fuel and thus has only a limited heat output.

In the natural water reactor the situation is reversed. There the correct volume ratio of water to uranium is of the order of unity and the critical diameter is again of the order of 10ft, depending on various parameters. Hence such a reactor must contain hundreds of tons of uranium and be operated at an economical heat output representing nearly a million kW loading. Both routes have their active protagonists.

The limitations and possibilities of these two approaches are best discussed in conjunction with the two diagrams presented. One shows the general circuit layout of a high-pressure natural water reactor, the other the circuit for a high-pressure water-cooled, solid moderator reactor, which is identical at the power end with the heavy water reactor, except that for the latter special attention has to be paid to reduce the hold-up of the pipework. Alternative ways of using the heat energy are indicated.

" Zephyr " experimental fast reactor at Harwell



In one scheme the high-pressure cooling water is circulated through two heat exchangers in series, the first acting as superheater, the second as an evaporator for the secondary circuit producing steam for a turbo-generator. There is a limit to the pressure which a reactor structure can be built to withstand, so the coolant temperature is bound to be substantially below the critical temperature of water. First of all one must keep a margin between the highest water temperature in the reactor and the boiling point of water at the operating pressure to avoid the risk of boiling. Then a substantial temperature difference is needed to transfer the heat from the surface of the fuel elements to the bulk of the cooling water, and some potential temperature is lost due to imperfect adjustment of the large number of parallel cooling channels in the reactor. Last of all, another substantial temperature drop is required to transfer the heat from the primary water circuit to the steam. As a result steam with adequate superheat can be produced only at quite low pressures. The main drawback there is that the steam machinery becomes very large. It appears that thermal efficiencies of a little over 20 per cent could be attained that way. The absence of the flue losses of a normal boiler is a substantial gain in the case of a low-pressure cycle.

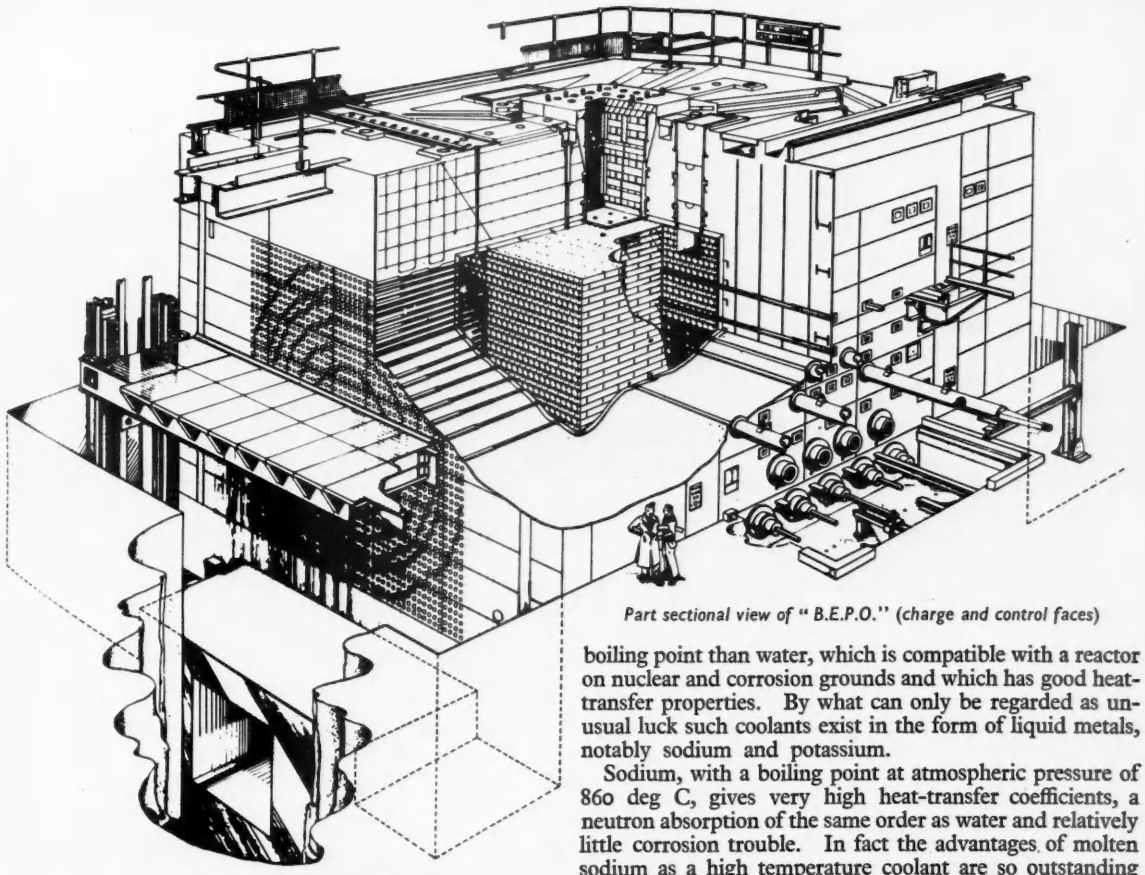
In an alternative high-pressure water cooling circuit the reactor heat is used entirely for evaporating water and superheat is supplied by an orthodox fired superheater. Such a plan allows one to operate at substantially higher steam pressures with a more efficient steam cycle so that the small amount of high temperature heat added by conventional means results in a disproportionate increase in the total output of the plant.

The design and operation of a high-pressure water reactor of one type or another is beset with a good many difficulties. In the intensive field of neutron and gamma radiation inside a reactor, all types of materials are affected to a greater or lesser extent. Generally speaking, all chemical compounds are gradually disintegrated and the more complex compounds break up faster. The decomposition of water can be kept under control but any impurities or additions are attacked very rapidly. Similarly all corrosion phenomena are greatly accelerated by the intense ionization present. A water-cooled reactor would therefore have to be operated with very pure water, and materials of construction resistant to corrosion and acceptable on nuclear physics grounds have to be found and developed. It has been reported that the reactor powering the United States submarine *Nautilus*, recently launched, is of the high-pressure water-cooled variety, so evidently these problems are capable of solution.

Very High Initial Heat

It will have become clear from the foregoing discussion that the production of large scale, low grade heat, which is difficult to utilize efficiently, is not due to any inherent physical characteristics of atomic energy. Indeed, the energy of the fission process is released on a molecular scale at a temperature of about one million degrees. The fundamental difficulty lies in the fact that one is trying to solve a novel set of circumstances by conventional means.

Materials of construction are limited, servicing is all but impossible, and the heat gained has to flow through a composite assembly of solid materials to a limited surface whence it must be carried to the point of utilization. The



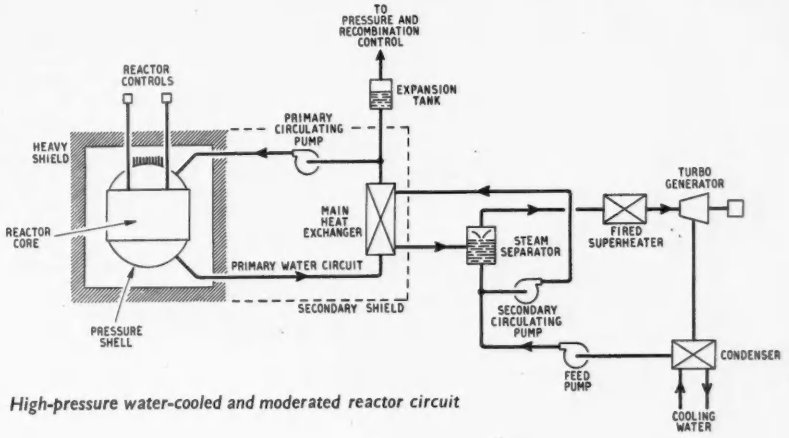
Part sectional view of "B.E.P.O." (charge and control faces)

highest temperatures are therefore inevitably at the most difficult point and also substantially in excess of the temperature levels which can be reached in the associated prime mover. So it seems likely that, in the end, novel ways will have to be developed to deal with a novel situation.

At least two approaches, from different angles, are open; the temperature drop through fuel elements and their heat-transfer surfaces could be avoided, thus yielding a higher temperature circuit. This is possible by having the fissile material in solution in the moderator, e.g., water, turning the reactor into a simple tank from which the hot solution is circulated through a heat exchanger. This route obviously suffers from temperature limitations only a degree less severe than those of pressure-water-cooled reactors. Moreover, the corrosion and decomposition problems are formidable. None the less, a reactor of this type would make it possible to devise some form of continuous processing of fissile material and fission products instead of having to manufacture elaborate metallic elements which must be dissolved in an acid bath when partially spent and then refabricated. The possible economic advantage of such simplified processing alone makes this type of reactor worth pursuing.

Another way of obtaining a higher power plant efficiency is to find a coolant with a higher boiling point than water, which is compatible with a reactor on nuclear and corrosion grounds and which has good heat-transfer properties. By what can only be regarded as unusual luck such coolants exist in the form of liquid metals, notably sodium and potassium.

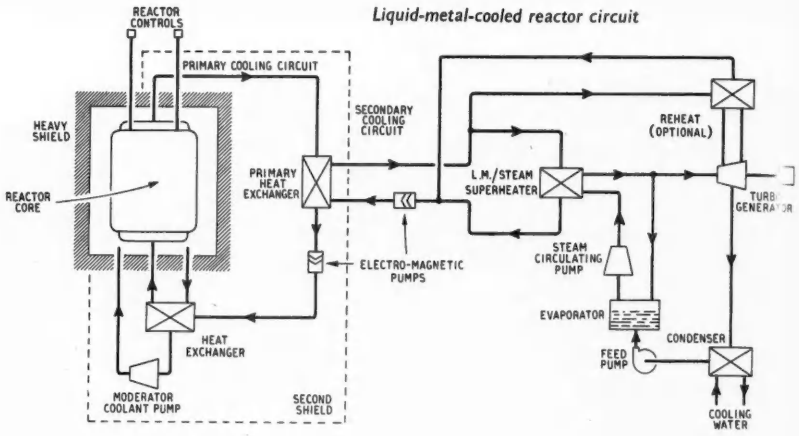
Sodium, with a boiling point at atmospheric pressure of 860 deg C, gives very high heat-transfer coefficients, a neutron absorption of the same order as water and relatively little corrosion trouble. In fact the advantages of molten sodium as a high temperature coolant are so outstanding that it is more important to detail the disadvantages and difficulties involved. The first and greatest obstacle to the large-scale use of sodium as coolant is the fact that an entirely new technology of handling, design and fabrication is required for which there is no industrial experience or precedent. Laboratory work in a number of different places has laid the foundations of this technology and many new devices, such as electromagnetic pumps without moving parts, have been developed. Yet a lot of leeway has to be made up before a new industrial technology in the full sense of the word is ready to be applied. On the purely technical side, sodium and the other alkali metals are very reactive; they have, therefore, to be handled with special precautions. Exceptional cleanliness has to be observed



High-pressure water-cooled and moderated reactor circuit

and all apparatus has to be leak-tight to standards normally found only in specialized high vacuum techniques. The reaction between water and sodium can be fairly violent, even in the absence of air, and this raises special problems. It would obviously be hazardous to have the two fluids side by side in a heat exchanger where the slightest fault could lead to a serious accident. Two approaches to solve this problem have been made. In one, heat exchangers or boilers of this kind have been built using a double barrier system. Concentric tubes in thermal contact with each other have been used to separate sodium from water with a gas space in between which can be employed to keep a continuous watch for leaks. Unfortunately, this system makes heat exchangers very large for their duty and rather expensive to construct. Alternatively the problem can be got around by transferring heat only from liquid metal to steam, which can be done without serious danger, and then using part of the superheated steam to evaporate water by recirculation. This has been done successfully at least on an experimental scale.

Liquid-metal-cooled reactor circuit



This short survey will show that the application of a novel technique of this kind is not a matter which can be achieved in a hurry, particularly in a field where the great hazards of intensive radioactivity and the impossibility of regular servicing require a very high order of reliability. It should provide a partial answer to the question raised in the title of this article. We must therefore reframe the question: How can the application of atomic energy be speeded up? The elements of the answer may be derived from precedent. The case of the gas turbine (or jet engine) is probably the best one to choose from recent times, provided it is kept in mind that the enormously greater cost of an experimental atomic power unit is an additional and very serious limitation.

The basic conception and design of the gas turbine was worked out by a small band of enthusiasts who foresaw the great possibilities of this new prime mover. The war, with its urgent need for higher speed aircraft, provided a powerful incentive to go ahead with the development as rapidly as possible and regardless of cost. The first major step of development from a speculative idea to some reasonably well functioning pieces of ironmongery was made under Government auspices and with the active assistance of many specialists in industry. Once the picture of what kind of machinery had to be produced was fairly well established the centre of gravity of practical and economical development shifted to industry, though still largely with Government support and with a strong backing of research in Government establishments.

We may expect atomic energy to follow a similar pattern. The stage is approaching when Government establishments with much detail help from industry will demonstrate what kind of "ironmongery" has to be created. So it is obvious that we must prepare the ground for industry to make the next large contribution. In the case of the jet engine this step was relatively easy. It was after all primarily a new type of aircraft engine and there was a large and highly developed industry in the field, accustomed to develop and build new and intricate machinery and threatened in its very existence if it failed to do so.

In the atomic energy field the situation is not so clear cut. In consequence we foresee an extended period in which the engineering and power industry at large will take an increasing interest in this new field and start to implement it by building up new teams of engineers of all persuasions trained in the scientific principles and technological requirements of atomic energy. A large part of this burden of training will inevitably fall on the existing atomic energy establishments. At the same time a greater share of experimentation and development work in the various problems associated with atomic energy may move to the same industries and there help to build up essential technical background. After that stage, which may well take several years, we may expect large industrial firms or groups of them to take on the complete design and construction of atomic power plants and bring the full weight of their organizational and technical resources to bear on a new subject of vital importance to this country.

Symbols, Signs and Abbreviations

WHEN it was decided to revise two well-established and partly overlapping British Standards, viz., B.S. 560 : 1934, "Engineering Symbols and Abbreviations" and B.S. 813 : 1938, "Chemical Symbols and Abbreviations," it was thought desirable to combine them so as to remove unnecessary conflict. It was decided, in the first instance, to deal with the more fundamental quantities of common concern to all branches of pure and applied science, on conventions relating to their use, and on abbreviations for relevant words, especially the names of units. B.S. 1991 : 1954, "Letter Symbols, Signs and Abbreviations"—Part I: General—is the outcome of this decision.

Besides providing recommendations for a wide, but by no means complete, range of quantities, the Standard is intended to give guidance towards the development of a general system. It urges that the general principles put forward should be accepted and followed rather than that there should be rigid adherence in all instances to recommendations on the use of individual symbols or abbreviations. In particular there should be no departure from the consistent use of italic type for symbols for physical quantities and of roman type for most other purposes such as abbreviations for words, including the names of units.

In the present revision and combination of the more fundamental features of the two British Standards full account has been taken of the recommendations of the Royal Society Symbols Committee and of the reports issued from time to time by such international bodies as the International Electrotechnical Commission.

Copies of this Standard may be obtained from the British Standards Institution, 2, Park Street, London, W.1, price 6s.

HOSPITAL INSTALLATION

Electrical Facilities in the New Outpatients' Department at St. James's Hospital, Balham

FLEXIBILITY is the keynote of the design of the electrical installation carried out at the new outpatients' department of St. James's Hospital, Balham. Designed as a completely self-contained unit with a frontage in St. James's Drive, this building at present consists of three storeys with provision for a further storey later. The layout provides for any section to be altered, such as enlarging or making a department smaller and introducing a new section. The electrical as well as all other services are required to possess the same degree of flexibility without disturbing the working of the remainder of the outpatients' department.

Composite Units

In preparing the electrical scheme the first consideration was to arrange for the various service outlets required in the rooms to be in positions where rearrangement of the "Holoplast" laminated plastic honeycomb section removable partitions would not necessitate extensive alterations to the installation. Early in the design stage it was determined that the cross partitions between the external walls and the corridor walls would in all cases be placed centrally on the external columns or on the centre mullion of the windows. Into each external column has been recessed a special Walsall outlet box having two removable cover plates on either side of a fixed centre position upon which the partition abuts. On each cover plate of this composite unit are fitted a 15 A 3-pin switch socket, a 10 A automatic switch socket and cord grip entries for internal and G.P.O. telephones and a spare outlet for use in connection with a patients' call system, details of which have not yet been decided. The box has internal partitions to separate each service and fixed connectors are fitted in the low voltage sections to take the flexible cords. The cover plates are split to allow the G.P.O. engineers to gain access to their compartment for maintenance work without coming into contact with mains voltage. The layout provides for adjacent composite wall units to be on different circuits so as to reduce the possibility of both sources of supply being cut off simultaneously.

Centrally between internal columns and directly over the cavity formed by the double skin corridor wall has been fitted flush into the false ceiling of the corridor a further composite outlet box having a lighting socket outlet and a short-circuiting impulse clock socket mounted on its cover plate, the two services being separated by an internal partition.

The lighting outlet in this box provides the source of supply to socket outlets, viewing screens, bracket lighting points and inspection lamps, etc., fitted on partition walls. The wiring is taken from the ceiling outlet box to the various outlets on the partitions via the void in the corridor wall to a chase formed around the internal column, entering the top of the partition where this abuts on the internal column. It is then continued along the top of the partition, dropping from the appropriate cavity to the outlet position. The wiring is concealed throughout its length and is accessible by removal of the aluminium cornices which cover the ceilings and chases in which it lies.

In the event of a partition being removed the wiring would firstly be isolated by removal of the plug top from the ceiling outlet box and then withdrawn. Should, however, the partition be replaced and the outlets with which it is fitted are appropriate for its new position, it would not be necessary to do more than remove the plug top and plug in at the ceiling outlet box nearest to the new position of the partition. The short-circuiting socket outlet in this box is arranged for connection of impulse type clock dials and the wiring to clocks is carried out via the partitions in exactly the same manner.

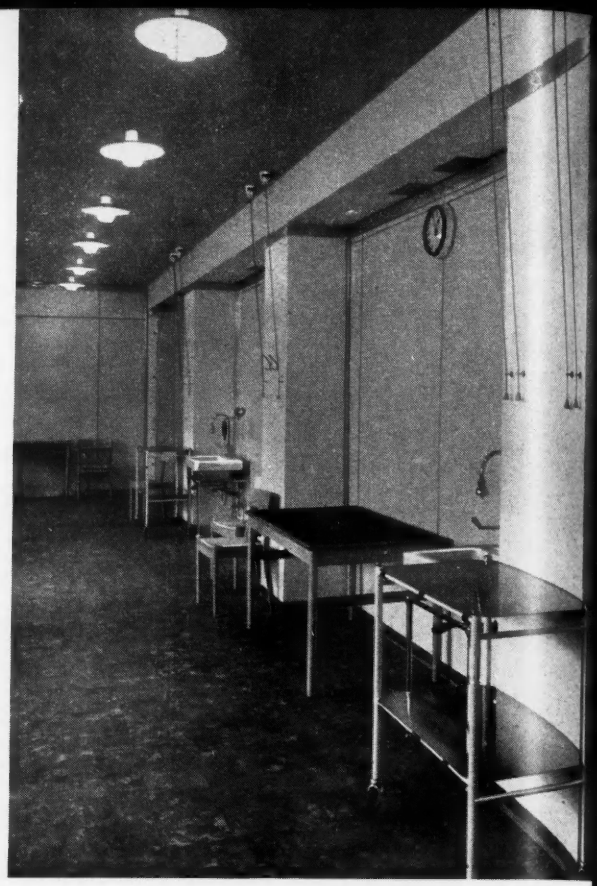
Lighting Point Arrangement

Ceiling lighting points have been fixed on the grid system in two regularly spaced rows 8ft apart running down the entire length of the areas allocated to rooms. The spacing (6ft) is such that the smallest room or cubicle

that can be formed has at least one lighting point. In the ceiling adjacent to and on either side of each internal column there has been installed a conduit box to take a ceiling cord switch. Thus there is always a switch position adjacent to the entrance to a room and by bringing the wiring from the fuseboard first to three-pin master sockets, it is possible to have any desired combination of lighting points controlled by any combination of switches. Wall switches have not been employed due to structural difficulties except on the outside walls and provision has been made for ceiling switches (Walsall a.c. micro-gap) at either side of the columns. This arrangement has the minor disadvantage that without special provision the switches are not always where one would normally expect them to be.

An extensive conduit system laid out in a definite pattern interconnects all lighting points with the switch positions to allow ample provision for any later rearrangements.

The above arrangements have made the electrical installation to room areas as adaptable as is the partitioning, the one being very dependent upon the other. P.v.c. insulated cable (B.I.C.C.) has been employed throughout by reason of its smaller diameter, smoother surface, apparent non-hardening with age and absence of staining, these qualities being most desirable where it is necessary

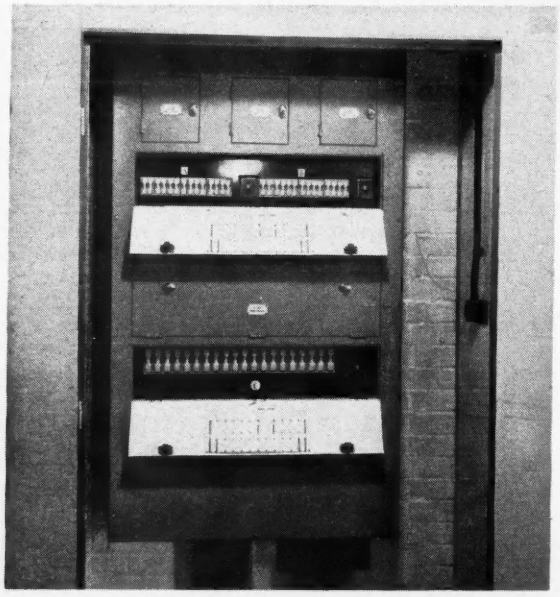


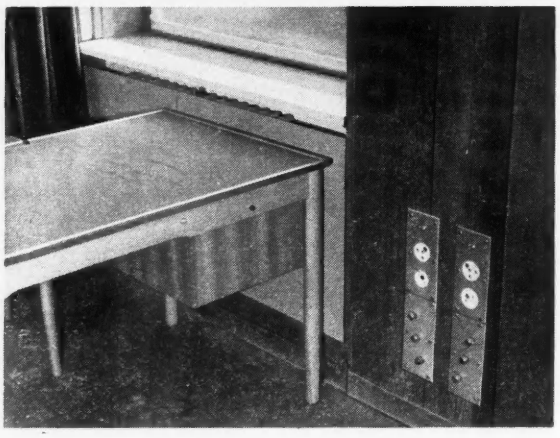
An idea of the flexibility of the lighting and switching arrangements is provided by this view of a part of the Orthopædic Department. Note the use of ceiling switches

to withdraw and draw in cables comparatively frequently in connection with the rearrangement of lighting to suit revised room layouts. Also the clean surface of the cable has prevented innumerable dirty finger marks on the finished decorations. In addition to the heating and lighting outlets incorporated in the composite units, points for floor polishers have been installed on structural walls in the corridors, waiting areas and lounge.

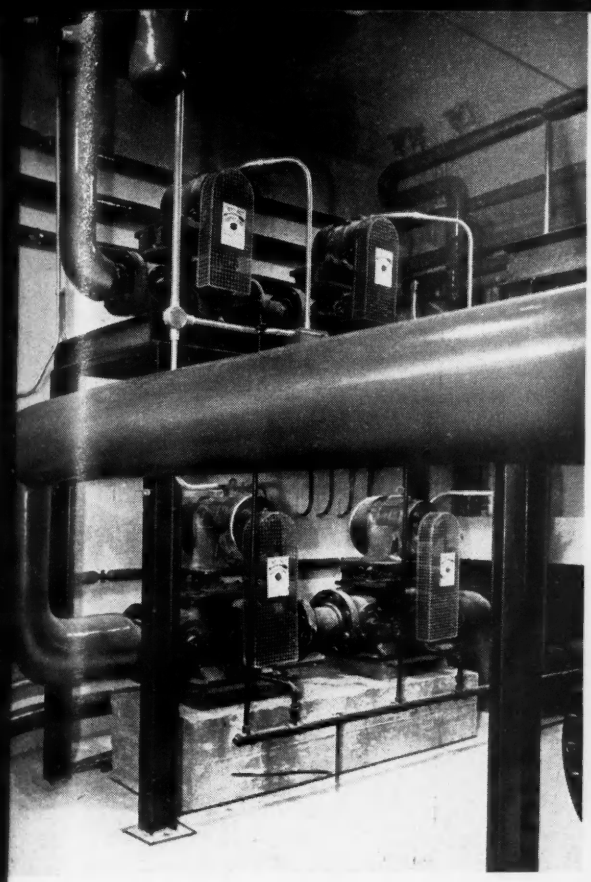
Distribution has been carried out on the rising main principle, a separate riser enclosed by a cupboard being installed in each block. The North Block riser terminates in the pent house on the roof and provides the supply to the two lifts, extract ventilating plant and local lighting. On each floor incorporated with the riser is a specially designed switch and fuseboard panel, constructed by Wm. White (Switchgear), Ltd., with lighting and heating fuseways arranged in banks, each bank having a 60 A micro-gap isolating switch and separate hinged access cover. The heating and lighting fuse-bridges are non-interchangeable. A floor plan with the positions of points is mounted on the inner face of the hinged cover of each fuseboard. Circuits are marked on the drawing to correspond with the fuseway numbers.

From the top and bottom of the fuseboard panels wiring trunkings are installed vertically to further trunking set horizontally in the ceilings and floors, with removable covers for access purposes and arranged to receive the conduits carrying the wiring to the various lighting and heating points. Three spare 60 A switches and fuses





Left—Top: One of these distribution boards is provided on each floor of each block. Diagrams give a complete picture of the wiring and fusing arrangements. Bottom: Pairs of composite socket outlet units covering power, lighting, telephone and patients' call systems are provided at each external column and are served by different sources of supply



An unusual double-deck arrangement of the duplicate tandem pumps used for the space heating and domestic hot water services

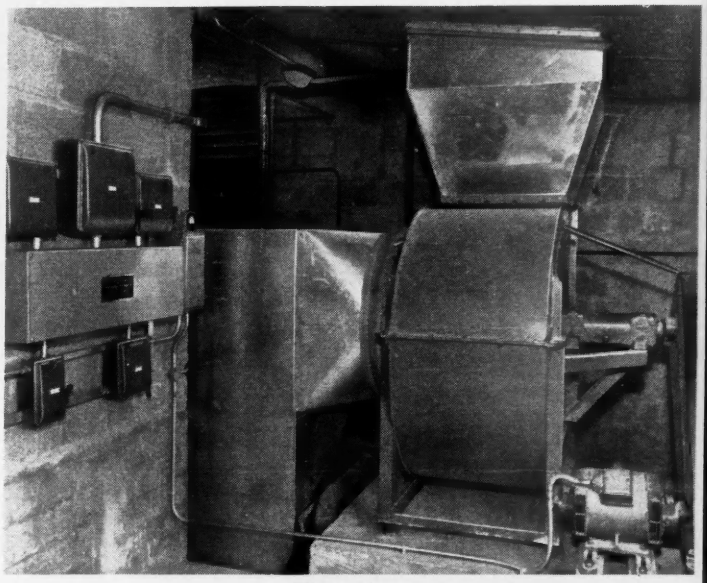
are provided in the top section of the panels in case a supply of over 15 A rating is required in some rooms at a later date. The wiring in this eventuality would be taken to the outlet positions through the void behind the corridor false ceiling, this void being accessible by unscrewing the removable softboard sheets forming the ceiling.

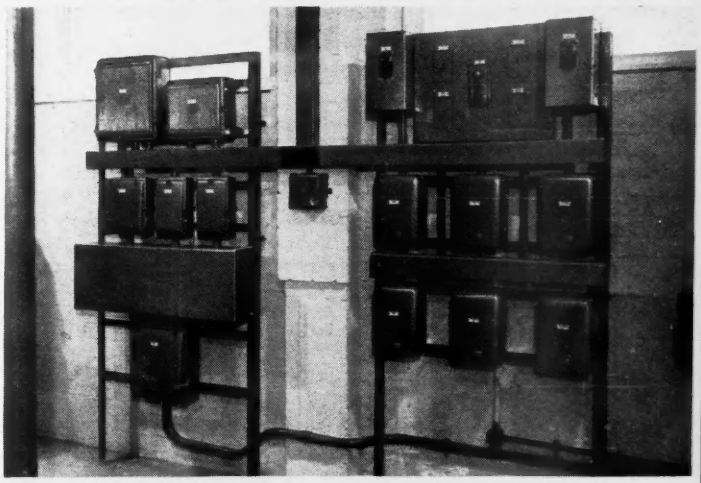
Because of the number of circuits involved the conduit system for lighting and heating was planned with the main conduit runs in the corridors, junction boxes being installed at appropriate positions therein from which further conduits fan out to lighting points, switches and composite units in the room areas. In addition to the conduit network for lighting and heating an underfloor duct system with triple duct runs has been installed in the screed to take telephone and call system cables.

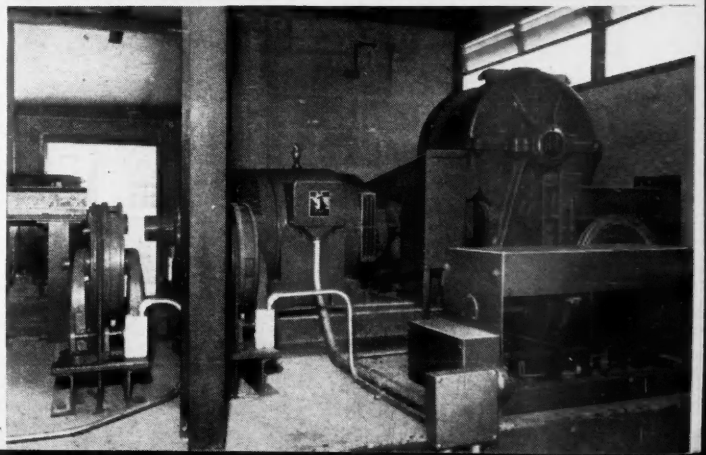
Underfloor Ducts

In the North Block these ducts commence at the same fuse cupboard as that accommodating the rising main and in the South Block at a separate fuse cupboard on the opposite side of the main waiting area to the rising main fuse cupboard. The main duct runs are taken down from the corridors and intersection boxes fitted with separators are fixed where the ducts turn at right angles and cross over the room areas to further junction boxes situated near the external walls. From these boxes conduits are run to the composite units on the external columns entering the section appropriate to their service.

The existing private 100 line Ericsson automatic exchange has been increased to 200 lines, the opportunity being taken to make desirable improvements to the existing equipment and its layout. The exchange building had to be enlarged to accommodate ultimately 300 lines. From the exchange 50-pair cables have been taken to each block, rising up through the fuse cupboards and connected at each floor to 50-line sub-main distribution boards. From the distribution boards an extension line is taken via the underfloor duct system to every composite unit, finishing at a fixed terminal block. The Post Office arranged its telephone installation in the same manner so that positions of both internal and G.P.O. telephone instruments may be altered without recabling.







Right—Top: The extract fan on the roof for the ventilating system which serves the whole building. Centre: The switchboards in the calorifier room for the remote control of the heating and ventilating plant. Bottom: One of the 12½ h.p. lift motors

A fire alarm system fed by a battery normally on trickle charge is installed throughout each block. Fire contacts are situated adjacent to all staircases and exits in the normal manner, the bells being placed centrally in the respective corridors. The system is wired back to the hospital's main indicator board in the Administration Block.

The 50 V 150 A " Nife " battery which supplies the fire alarm system also provides the supply for emergency lighting of the corridors, staircases, calorifier room and the lift cars. The corridor points are housed in simple circular recessed fittings having a wide angle of illumination. The emergency lighting switches are arranged to operate automatically.

A Synchronome impulse clock system has been incorporated in the scheme and spare circuits are provided on the distribution board for extending the system to the other hospital blocks at a later date. A number of clocks have already been fitted and many more may be installed by plugging into the short-circuiting socket incorporated in the composite unit in the ceiling between internal columns as previously described. The short-circuiting socket prevents stoppage of other clocks in the series circuit if a clock is disconnected.

Lighting Installation

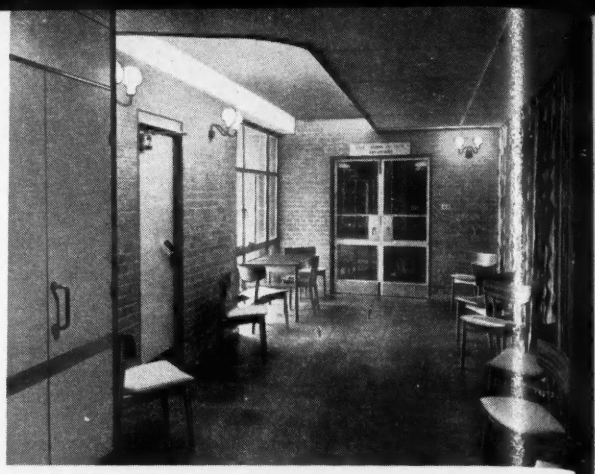
In the selection of lighting fittings, all of which were made by Merchant Adventurers of London, Ltd., careful consideration was given to efficiency and maintenance. Many of the fittings were specially designed to allow re-lamping, cleaning and other maintenance work to be quickly and effectively carried out. Though there is much variety in the lighting fittings, the glassware has been standardized, a brandy glass shape being selected for general use. The level of illumination is generally high in all working areas (about 12 ft-candles) and it is hoped that this will make unnecessary the use of supplementary lighting in the form of table and inspection lamps, etc., the flexible cords of which are always a nuisance and require frequent repair.

Special lighting effects have been carried out in the lounge and waiting areas in the form of concealed fluorescent cornice lighting. The general lighting in the lounge is given by three large nine-lamp chandeliers. Indicator lamps and illuminated signs are provided outside the doors of the electro-cardiograph screening and dark rooms. The amber lights installed outside the undressing cubicles of the gynæcology department are illuminated by the operation of small rotary switches (Julius Sax) incorporated in the door locks, a master control being provided. Viewing screens (Technical Lights and Equipment) are fitted in most consulting rooms for the inspection of X-ray films and are provided with dimmers to vary the illumination of the screens. The subways under the blocks are adequately lighted by bulkhead fittings and low voltage units for handlamps are also provided.

Heating and Ventilation

As in the case of lighting, all apparatus concerned with the heating is duplicated, enabling any repair or maintenance to be carried out without interfering with the running of the department. Both space heating, which is by means of " Vectairs " and low temperature embedded pipe coils, and domestic hot water are supplied through calorifiers fed with steam from the main boilerhouse. Each service has dual pumps (F. A. Pullen & Co., with Brook motors) arranged in tandem, an unusual feature being the method of mounting one pair above the other. All condensate is returned to the boilers.

Every motor is fitted with an isolating switch and is remotely controlled from a board constructed with a Varilectric busbar chamber, G.E.C. switch-fuse gear and Brush direct-on-line starters. Remote control is also provided here for a general ventilating system, the extract fan for which, an Airscrew unit driven by a 1 h.p. Bull motor, is mounted on the roof. The heating system is thermostatically controlled throughout with switches providing for a reduction in temperature at night.



Fluorescent cornice lighting in the lounge waiting hall is supplemented by nine-light pendants with recessed ceiling units in the entrance hall

Two 15 cwt Hammond & Champness lifts serving all floors are driven by 12½ h.p. Bull motors and have automatic power operated gates. A further electrical feature, for which experiments are still proceeding, is a radio system of calling patients from the central waiting spaces on each floor to the consultants' rooms. The complete installation has a loading of about 55 kW.

The electrical demand of the new outpatients' department necessitated the introduction of a three-phase 4-wire service to the hospital. The London Electricity Board has installed a transformer on site. The new feeder cable to the outpatients' department forms one leg of a ring-main system of main distribution to be completed when the whole hospital changes over to the new three-phase service. At present the remainder of the hospital operates on a single-phase 3-wire system, a relic of the days when direct current was the system of supply in the district.

The architects for the new department were Messrs. Devereux and Davis, Mr. H. A. Sandford being the consultant engineer. The electrical contractors were Johnson, Pearce & Co., Ltd. We thank Mr. Sandford and his staff and Mr. C. H. Clemence, chief engineer of the hospital, for their assistance in preparing this article

NEW BOOKS

The Synchronous Induction Motor. By J. Griffin. Pp. 136; figs. and index. Macdonald & Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 18s.

As the author remarks, there is comparatively little published information relating to synchronous induction motors, other than that which appears from time to time in the form of articles and short sections in books on electrical engineering or motors in general. Nevertheless, these machines are important and may become more widely used as the need for maintaining loads at high power factor is stressed.

The author deals with starting, theory, synchronizing, dynamic braking, secondary windings, construction, etc., in the general way which may be expected in such a review. He has also devoted about a quarter of the book to the important subjects of power factor correction, automatic excitation control and synchronous overload capacity, this part of the volume being particularly useful.

Although a chapter has been devoted to exciting current calculations little attention has otherwise been paid to design, although there is a useful list of reference books. While many authors have difficulty in accommodating the available information in the space at their disposal it may seem that, in handling a specialized subject such as synchronous induction motors, the author might have completed the work by dealing more fully with design, and perhaps with practical aspects such as possible operating troubles. The book can be recommended to electrical engineers in general and to students and teachers of electrical engineering.—J.L.W.

Low Frequency Amplification. By N. A. J. Voorhoeve. Pp. 495; figs. and index. Philips Technical Library. Cleaver-Hume Press, Ltd., 42a, South Audley Street, London, W.1. Price 50s.

The contents of this book cover a much wider field than is implied by the title for, in addition to the study of valve amplifiers for audio frequencies, Dr. Voorhoeve deals with electrical components for amplifiers, rectifiers and power units, the relevant principles of acoustics and their use in sound systems, engineering, microphone and other "pick-up" devices, loudspeakers and recording systems used for special applications (e.g. railway stations, exhibitions, etc.), relay systems and measurements.

The book is designed to cover the whole field of electro-acoustic engineering applications without going into great theoretical detail, although the necessary design relations are derived and such topics as valve distortion are treated in full mathematical detail. The book should be very valuable to engineers engaged in public address and similar fields. Electronic engineers concerned with a.f. amplifier design will find it a clear and logical account with rather more practical detail and illustrative circuits than is usual. Copious references are included and attention is not confined to Philips products.—A.H.B.

Direct-Current Circuits. By Earle M. Morecock. Pp. 388; figs. and index. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 40s.

Designed for use in early courses in static and current electricity and magnetism, this book starts with the simplified structure of matter for which it uses the well-trodden paths of mechanical and hydraulic analogy in current theory. Then a set of American conventional symbols (non-standard by B.S.I.) are given with wiring diagrams leading to series and parallel circuits. Magnetism and electromagnetism are treated with the minimum use of mathematics and the maximum of words and diagrams. Measurement of voltage, current and resistance takes two chapters. Power and energy reintroduces a unit which was believed to be dead, viz., the *slug*, i.e. the mass which is accelerated at 1 ft/sec by a force of one pound weight; it is apparently the *English Unit*. Also the student may be confused by mention of "relativity" change in mass, which is hardly of importance or interest at such a level. Conductors and insulation, batteries, networks, magnetic circuits, electromagnetic induction, and capacitance with electrostatics form other chapter contents.

The text has been converted into rationalized M.K.S. units, and this has led to some odd inconsistencies. For example, the unit of resistivity is given (correctly) as the ohm-metre (or *meter*), while conductivity is given in mho metre, rather than mho *per* metre. The archaic term mhos per centimetre cube also crops up and the cumbersome looking expression ohm per circular-mil-foot for resistivity.

Unfortunately the method of presentation, non-standard symbols and unusual units are likely to render this book extremely misleading to most British students.—E.H.S.

Modern Armature Construction, Winding and Repair. By Stuart F. Philpott. Pp. 280; figs. and index. Sir Isaac Pitman & Sons, Ltd., Parker Street, Kingsway, London, W.C.2. Price 30s.

Small electric motors are now used in large numbers in all spheres of life, and will probably be used still more widely in future if the cost of these machines can be kept within reasonable limits. Low production costs entail the use of machines to minimize expensive labour as far as possible, and Mr. Philpott has evidently had this factor in mind. The result is a book which lives up to its title, and describes modern methods of performing all the operations necessary in winding an armature, instead of merely describing how coils should be arranged, insulated and connected.

While this work is not intended to deal with design, the basic principles of armature windings are mentioned in the opening chapter, including some excellent, easy to follow, diagrams of various types of windings which will interest students. The chapter on armature construction covers modern methods of producing the stampings and shaft, followed by details of the construction of various types of commutators, insulating methods, and up-to-date methods of winding. Armature faults and testing are fully described, as also are finishing methods. An excellent description of balancing methods is also included.

The author has not attempted to deal with field windings or the stator windings of a.c. motors; possibly these subjects are reserved for another volume. Although there is a short section on repairs to armatures the emphasis of this book is definitely on production methods.—J.L.W.

Statistical Methods in Electrical Engineering. By D. A. Bell, M.A., B.Sc. (Oxon), Ph.D., M.I.E.E. Pp. 175; figs. and index. Chapman & Hall, Ltd., 37, Essex Street, London, W.C.2. Price 25s.

This book is intended for "students and professional engineers who require a concise work on the theory and application of statistics to electrical engineering." It will also appeal to many physicists and industrial statisticians

who will find in it a valuable integration of technological and statistical theory. Those who seek guidance on shop-floor applications of statistics, however, would be advised to look elsewhere, for the book is not intended as a working manual.

The first part deals with probability theory, classification by attributes and the X^2 test. Two chapters are devoted to frequency distributions and another to curve fitting, including the use of probability paper. In attributing the specially distorted scale to A. F. Dufton (1930), however, the author apparently overlooks the work of A. Hazen in 1914. The book continues with the periodogram and the auto-correlation function, followed by the reliability of data and quality control. The final chapters are on fluctuations, and entropy and information theory.

References to sources of statistical tables are given in an appendix, but it would have been helpful to non-statisticians to have included tables of t, r and X^2 in the book. On quality control the author speaks of " . . . relaxing the production tolerance to the point where quality control becomes relevant "; yet when tolerances are *tighter* than the random variation in a process, control charts are equally necessary to avoid over-adjustments. It is likewise misleading to suggest that statistical control never employs " last off " samples or that it only applies when a proportion of product is measured. Control charts of 100 per cent inspection results are often useful. Under batch sampling, A.O.Q.L. is presented as " average outgoing quality level " instead of " average outgoing quality *limit*." These are small points, however, and the book can be recommended both for its subject-matter and for its lucid style.—R.H.S.L.

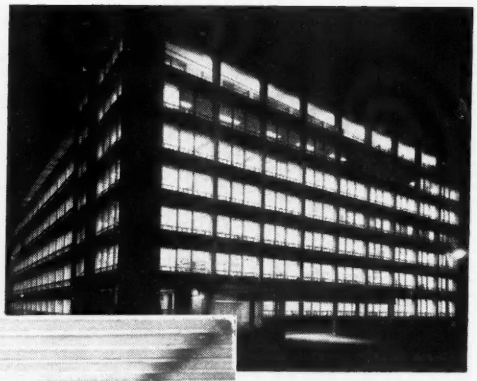
" Luminated " Ceilings

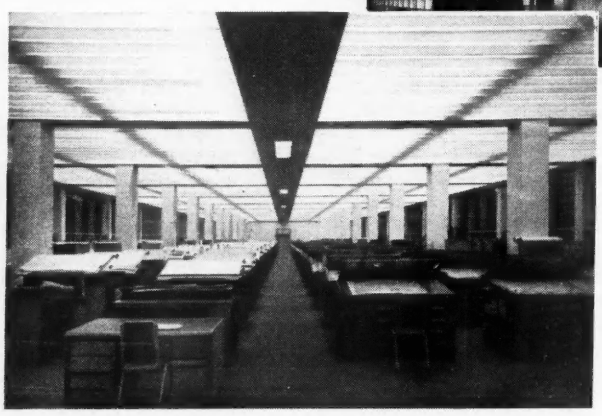
C. A. Parsons' Research and Design Building

POST-WAR expansion in the output from the Heaton Works of C. A. Parsons & Co., Ltd., Newcastle-on-Tyne, necessitated a corresponding increase and improvement in the accommodation for research and design work. A new research and design building has now been completed which incorporates many advanced features in construction and equipment.

In planning the lighting installation it was decided not only to provide the high illumination of 85 lumens per sq ft over large areas of floor space, but to evolve a scheme specially adapted to the needs of a building where, by an effect of perspective, the size of many offices would give a false impression of low ceiling height if ordinary ceiling-mounted fittings were used. A scheme was prepared for embodying cold cathode tubes in the ceiling construction in such a way that over the greater part of their area the ceilings themselves would appear to be sources of light. This has been achieved by means of rows of reflectors which form the under surface of the ceiling, and run at right angles to the normal direction of view from the office desks and drawing boards so that the lighting tubes are concealed.

The reflectors are of anodized aluminium and are perforated to prevent echo, sound being absorbed by insulating blankets above the fittings. These reflectors also assist the heating system of the building, for the reflectors are clipped to the rectangular hot water pipes in the ceilings and therefore form a very large radiant panel. The average heights of the tubes above floor level in the offices are 12ft 6in or 9ft 6in.





A night view of the new Research and Design Building of C. A. Parsons & Co., Ltd., at Newcastle-on-Tyne, and (below) the " luminated " ceiling in the main drawing office

Attention was given to the optical design of the reflectors in order to avoid a harsh shadow at their longitudinal junctions. As a result there is nothing to give a definite impression of where the ceiling begins, and the impression of a low ceiling is avoided.

The whole lighting installation in this building incorporates some 7,000 " Osram " intermediate white cold cathode tubes, with a combined length of about 12 miles. Acoustic panels form the ceiling at the ends of, and between, the areas of continuous lighting, and the transformers are concealed above. Four tubes are operated from each transformer. Switching is normally automatic under photo-electric control, which first switches on the tubes in the central areas and then those near the windows and operates through G.E.C. 23 A, 4-pole contactors.

The entrance hall, where there are showcases containing historic models made in the course of Sir Charles Parsons' early experiments, is lighted by cold cathode tubes installed above twenty laylights. All corridors are normally illuminated by " spill " lighting from offices through glass partitions, but are provided with laylights for use as pilot lights when office lighting is extinguished. Staircases are lit by lines of cold cathode tubes behind glazed panels on the landings.

The frontage has 85 W sodium floodlights on the top balcony and three 400 W mercury units in the forecourt.

VIEWS on the NEWS

By REFLECTOR

SOME notes have appeared in the *Liverpool Daily Post* on the subject of a Welsh "T.V.A." (Tennessee Valley Authority). Advocacy of such a scheme was common a few years ago but I thought that the idea had been dropped. Now apparently it has been resuscitated with the support of the Caernarvonshire County Council. It is reported that members of the Welsh Economic Development Association have secured the views of the American T.V.A. staff who say that they have been "impressed by the many similarities between the conditions and problems of Wales and those which the Tennessee Valley has faced." But the similarities are not so great as the differences. The T.V.A. was formed primarily for the purpose of flood control and navigation—electricity was a by-product, albeit a very important one. The Welsh idea is to set up a "T.V.A." purely for electricity production and distribution. It is part of the plan to transfer all power generation, whether by water, steam or wind, to the Authority. The latter would be very different from the T.V.A.

* * *

The following story appeared in the "Fens Review" section of the Eastern Electricity Board's monthly magazine for April:—

> "In some countries the supplies of electricity and gas are in the hands of the same Companies. Presumably a consumer of ours thought that some such system operated in Cambridge for when our Installations Inspector called he found a number of gas brackets which had been converted to lighting points by the simple expedient of passing a length of flex through the gas piping. Out of curiosity the Inspector tried the gas tap and found that supplies of gas were still passing through the same pipes. However convenient this might have been in the event of a breakdown we thought that merging the two services so closely was rather too much and removed the tails from the meter."

This may be quoted as an example of the lack of the co-operative spirit shown by the electricity supply industry.

* * *

Halifax members of the Grocers' Association expressed their views on sugar prices at a recent meeting. It seems from a report in the *Grocer* that the Yorkshire Council of the Association had recommended 1s 3½d (for 2 lb) but some members were charging only 1s 3d. One speaker said it seemed foolish that they should always be raising the question of higher profit margins while the price recommended by the Association was being cut. Another member considered that they ought to be able to stop this practice. I mention this discussion, which appears to be quite alien to the *Electrical Review*, only because earlier in the meeting reference was made to a protest against the new commercial tariff of the Yorkshire Electricity Board. Other people's prices are always too high of course.

* * *

The shilling shortage still persists. The latest news about it is that the Treasury has informed the Monmouthshire Urban District Councils Association that last year 63 million shillings were supplied and issues are now being made at twice that rate. Suggestions had been made by the Association to the South Wales Electricity Board that sixpenny and shilling, or penny and shilling, prepayment meters should be provided but the Board pointed out that this would be far too expensive. Another proposal was that the Board should supply a "reservoir" of shillings (a term invoking thoughts of vast quantities) in each district. The Board replied that it did not imagine that many customers would make a special journey to the central point. Nevertheless the Association has decided to press the Board further on this "reservoir" idea.

* * *

It is reported that unless a satisfactory electric poker for igniting smokeless fuels can be devised, Walsall may have to abandon a proposal to make the Mossley estate of 1,600 houses into a compulsory smokeless zone. It is proposed that half the houses shall be equipped with gas cookers and washboilers and half with electric cookers and washboilers. It is gratifying to learn from the *Leicester Mercury* that "it is not intended to supply the all-electric houses with gas solely for the purpose of lighting fires with gas pokers." But why light fires at all in all-electric houses?

* * *

It is only with the greatest reluctance that the gas industry generally has conceded street lighting to electricity and a recent statement by Mr. E. Crowther, chairman of the Northern Gas Board, displayed unusual candour. As reported by the *Evening Gazette* (Middlesbrough) Mr. Crowther told the Northern Gas Consultative Council that they were bound to agree that electricity could do a better job on lighting than they could.

> "We made very great efforts to retain street lighting before the war to the extent of selling gas a long way under cost. Improvements in electric lighting since then have been such that it would be mistaken and not in the national interest to press the claims of gas for this use now."

I will be equally generous and admit that the gas poker has no rival in its field.

* * *

This week's echo from the past comes from the *Electrical Review* of 1st May, 1874 (eighty years ago). It is an advertisement (in defiance of medical etiquette) by a Dr. Hayward, M.R.C.S., reading as follows:—

> "Medical Electricity. How to use successfully, with safety and success, in all cases of weakness, low spirits, despondency, languor, exhaustion, constipation, nervousness, muscular debility, loss of strength, appetite, etc., etc., without medicine or recourse to spurious appliances issued by men devoid of medical education. Full printed instructions and diagrams for invalids. . . . Electricity revives the failing functions of life, and thus imparts energy and fresh vitality to the exhausted and debilitated constitution, and may fairly be termed the Fountain of Health."

In the Courts

In the Queen's Bench Division recently Mr. Harris Shapiro, of Stepney, and his wife claimed damages against Mr. D. Jay, trading as "Jay's for Wireless" at Commercial Road, London, E., for injuries received when a bathroom towel rail became electrified (see *Electrical Review*, 2nd April, page 601). It was stated that the rail was connected with a metal kitchen shelf on which a portable radio set had been placed. Plaintiffs alleged that Mr. Jay had been asked to repair the set which, when returned, was placed on the shelf. Mr. Jay, however, denied that he had been asked to repair the set. He said that, following a complaint of interference with reception, he sent an assistant to listen, but the set was not repaired or removed from the flat.

Mr. Justice Finnemore, in a reserved judgment, held that the set had not been repaired by Mr. Jay. A boy of fifteen who was sent had moved the set to the shelf on request. The claim was dismissed.

Builders' Libel Action Settled

Before Mr. Justice Glyn-Jones in the Queen's Bench Division on 7th April a settlement was announced of an action brought by Custodis (1922), Ltd., building contractors, London, against the *Huddersfield Examiner* for damages for an alleged libel in that newspaper. The judge was informed that the plaintiffs had accepted a sum which had been paid into Court.

Plaintiffs' Counsel (Mr. Neville Faulks) said that the company was erecting a chimney at Huddersfield for the British Electricity Authority. The article complained of compared the chimney with the Leaning Tower of Pisa and the crooked spire at Chesterfield. Actually, said Counsel, the chimney had been built to the satisfaction of the B.E.A. and was straight and true, in accordance with his clients' invariable practice.

Counsel for the defendants (Mr. Neil Lawson) assented to the statement.

A.E.U. Member's Application Refused

In the Chancery Division on 14th April Mr. Justice Harman refused an application by Mr. Leslie C. Huntley, an engineering worker of West Hartlepool, for an injunction restraining a number of officials of the Amalgamated Engineering Union from preventing him from obtaining employment.

The evidence showed that Mr. Huntley refused to join in a 24-hour strike called by the Union in December last. He was employed by a West Hartlepool firm of engineers and the firm was asked to dismiss him. The firm refused to do this but his fellow employees "sent him to Coventry" and he left the firm of his own accord.

He then obtained employment as a fitter-driver at the North Tees power station of the B.E.A. but was later told that his presence was causing difficulties with the men at the station and his employment was ended.

It was stated for the Union officials that he had ignored the Executive Council's instruction to strike and had thereby incensed Union members in the district.

The judge said that although he had great sympathy with the applicant this was not a case in which he could interfere by interlocutory relief. The reason for his falling-out with the Union and officials, and possibly other persons in the district, appeared to be the childish expedient of a one-day strike with which Mr. Huntley did not agree. His Lordship recognized that the Union had taken a moderate view of the matter and had said that all Mr. Huntley should suffer was censure for not obeying the Union's instructions. He hoped that wiser counsels would prevail on Tees-side and that some attention would be paid to the Union's views.

Snowy Contracts

Last week we briefly reported the awarding of a constructional contract in connection with the Australian Snowy Mountains irrigation and hydro-electric scheme to an American group, and generating plant contracts to the English Electric Co., Ltd., and the A.S.E.A.

Our Australian Correspondent now informs us that these two contracts, part of the Adaminaby-Tumut section of the Snowy River scheme, are designed to produce 160 MW in 1958–59 and a further 160 MW by 1959–60. The Minister for National Development, who announced the Cabinet's decisions, also revealed that the Snowy Mountains Interim Advisory Council had reported that in all circumstances Snowy power would be cheaper than thermal power. Senator Spooner said that eighteen tenders for the construction contracts had been received from constructors in America, Scandinavia, Germany, France and Australia, but none from British firms.

The two civil engineering contracts given to the American contractors, who were known as Kaiser - Walsh - Perini-Raymond, were "schedule of rates" contracts in which the accepted price would be subject only to variations caused by changes in wages, the cost of certain materials and for actual quantities of work performed.

The total of the tender price was £A25,296,586, and it stipulated approximately 6½ years for completion of the tunnel and 4½ years for the Tumut ponds, dam and associated work. Penalties are payable by the contractors if the work is not completed on schedule, but there are no bonuses payable for earlier completion.

Senator Spooner said that the A.S.E.A., which had been given the contracts for two generators, had submitted a tender of £552,320 through its Australian firm A.S.E.A. Electric (Aust.) Pty., Ltd. The English Electric Co., Ltd., had submitted a tender of £460,945 for two water turbines which had been accepted. Other tenders covering construction of the T.1 power station would be considered in due course. Japanese tenders had been received for the generating equipment but they were not favourable either on price or other aspects.

Parliamentary

In the House of Commons last week Mr. Hastings asked if the Minister of Fuel and Power would give instructions that no more power stations should be built within 30 miles of London until some method was discovered to rid flue gases of harmful sulphur oxides.

Mr. Lloyd said that in accordance with the general policy of generating more power in the Midland coalfields there would be a reduction in these particular stations.

New Capital Investment

Mr. Palmer asked the Minister of Fuel and Power if he would state the total new capital investment of the nationalized coal, electricity and gas industries since vesting date in each case, and corresponding figures for the period before the war.

Mr. Geoffrey Lloyd said that the amounts in round figures were £240 million, £810 million and £205 million respectively. Figures of pre-war investment were not available for coal or gas. For electricity the figure for the six years before 1939 was about £200 million—which would be equivalent to a figure perhaps three times as great in present-day money.

Electric Wires and Cables

Mr. Singler asked the Minister of Supply if he was now in a position to state the date on which he would declare the Government's policy on the recommendations of the Monopolies Commission about the supply of electric wires and cables.

Mr. Low, the Parliamentary Secretary, said that the Minister hoped to be in a position to make a statement shortly after the Easter recess.

Search for Natural Gas

Mr. Palmer asked the Minister of Fuel and Power if he would make a statement on progress made in the search for natural gas.

Mr. Geoffrey Lloyd said that an area totalling some 3,680 square miles in various parts of England and Scotland had been chosen for prospecting purposes. Geophysical surveys were being carried out in Yorkshire and Lincolnshire; a deep borehole was being drilled in Scotland, and it was hoped to start deep drilling in Sussex soon.

Intenser Electrical Development

Encouragement from the Minister of Fuel and Power

Before the E.D.A. luncheon (left to right) Mr. J. I. Bernard, Lord Citrine, Dame Caroline Haslett (chairman), Mr. Herbert Morrison, Sir Henry Self, Mr. Geoffrey Lloyd (Minister of Fuel and Power), Mr. L. W. Joynson-Hicks (Parliamentary Secretary), Mr. E. Shinwell, Mr. Alfred Robens, Mr. J. Chuter Ede and Mr. V. W. Dale (E.D.A. director and secretary)

AFTER the break last year in the post-war series of annual luncheons, the British Electrical Development Association held a most successful "revival" luncheon at Grosvenor House, London, W.1, on Wednesday, 14th April.

Sir Henry Self, president, took the chair and Mr. Geoffrey Lloyd, Minister of Fuel and Power, was the principal guest and proposer of the toast of "Electrical Progress." After recalling a *Punch* cartoon of 1881 in which the giants "Coal" and "Steam" prognosticated a future for the infant "Electricity," seen in a cradle, Mr. Lloyd made a reference to the enormous possibilities inherent in atomic energy. This, he said, could only be distributed and used in the form of electricity.

Electricity in the Home

While undoubtedly electricity was playing a primary part in industrial expansion, the greater use of electricity in the home was also of the first importance. The very great decrease in the number of domestic servants made it imperative to find means of lightening the load of work in the house. He made particular mention of the thermostatically and time controlled cooker and the washing machine.

The Association had a wonderful field and prospect because of the expanding amount of power which was becoming available. Electricity played a very great part in providing the material basis for social progress.

Replying to the toast, Sir Henry Self welcomed the Minister's announcement of the policy of relieving the housewife from her labours by means of electricity. Policy was not often enunciated so clearly and it was now his duty as an ex-Civil Servant to see that it was carried out. Not only more power but more efficiency was the aim. If prices were to be kept down the load factor must be improved. Coal costs were high and although they were offset by increased generating efficiency only an improved load factor could enable them to meet the heavy capital charges involved in the new plant. He said that the Minister's announcement would encourage this improvement and diversity of use.

Reminding his audience that the electrical manufacturing industry was the second largest of this country's exporting industries, Sir Henry said that the electricity supply industry with its £1,500 million investment in electrical plant had provided a sound base for a flourishing export trade. Exports of light equipment would likewise be fostered by the establishment of a sound home market. One thing which E.D.A. desired to see was the removal of purchase tax.

Sir Henry concluded by thanking the Minister for enabling them to go ahead with development and said that the election last year of Dame Caroline Haslett as chairman of the Association was a symbol of their purpose.

The health of the guests was proposed by Dame Caroline Haslett who said that in 1952 Mr. Geoffrey Lloyd exhorted the electrical industry to help to improve productivity; now he was advocating the improvement of the housewife's life by lightening her labours electrically. On behalf of the women she thanked the Minister for his encouragement. In a reference to the presence of Mr. Emanuel Shinwell, Mr. Alfred Robens and Mr. Herbert Morrison, she said that once Mr. Morrison had been offered the post of chairman of E.D.A. at a salary of £5,000 (and expenses). He had declined the offer and since then the chairmanship had carried no salary, although it involved a great deal of hard work.

All kinds of opportunities were now opening up before E.D.A. after years of inability to go ahead. There were more women present at the luncheon than ever before; she welcomed the growing appreciation in the industry of the part played by women. Referring to the presence of Mr. Harold Bishop, President I.E.E., Dame Caroline said that the idea of E.D.A. emerged from an I.E.E. paper in 1918.

Mr. L. W. Joynson-Hicks, Mr. J. Eccles, Sir Edwin Plowden, Lord Citrine, Lady Citrine, Mr. Geoffrey Lloyd and Sir Henry Self

Mr. Harold Bishop, responding to the toast, said that it was indicative of the esteem in which E.D.A. was held that so many distinguished people were at that gathering. He mentioned the Electrical Cooking and Heating Committee set up in 1918 to prepare a scheme of electrical development. E.D.A. was formed in 1920; its first report said that manufacturers and contractors were labouring ceaselessly for small reward. He hoped that the great amount of apparatus which would be installed as a result of the present campaign would be interference-free.

The Association's publicity matter was virile and attractive and full of ideas. The I.E.E. could help actively through scientific advice from its members and the B.B.C. had done quite a lot to help on with the work.

ANNUAL MEETING

Dame Caroline Haslett (chairman) presided at the annual meeting which followed. Adoption of the accounts was moved by Mr. S. F. Steward (chairman, Finance Committee). He said that the year's expenditure had risen from £207,000 to £298,000 mainly because of increased advertising and greater participation in exhibitions and agricultural shows. Expenditure on technical services had gone up by £5,000 and £2,000 had been contributed towards the cost of the electrical exhibits at the Science Museum. Subscriptions had risen from £209,000 to £295,000. Mr. T. E. Daniel seconded the adoption of the accounts.

Presenting the annual report (reviewed in our last issue), Dame Caroline Haslett said that they were now spending a quarter of a million on their activities (excluding films). She referred to the success of the films, to the opening of the new Testing House and participation in 22 exhibitions. She concluded by thanking Mr. V. W. Dale (director and secretary) and his staff. Miss N. Kenyon seconded the resolution.

Dame Caroline reported the election of Sir John Hacking as president in succession to Sir Henry Self, and then proposed a vote of thanks to Sir Henry, expressing her appreciation of his active work for the Association during the past year. Mr. C. T. Melling seconded the vote in felicitous terms and it was passed by acclamation. Sir Henry Self briefly responded.

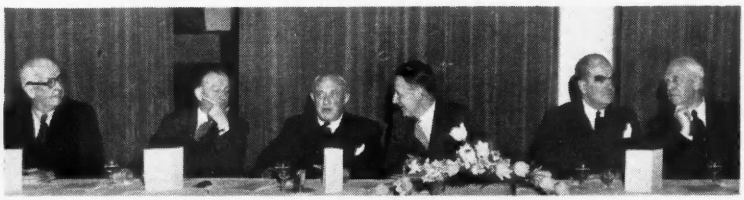
Dame Caroline then reported that Sir Harry Railing (General Electric Co., Ltd.) had been elected a vice-president, and that the following vice-presidents had been re-appointed for a period of three years:—Dame Caroline Haslett, Lord Beveridge and Capt. J. M. Donaldson.

Moving a vote of thanks to Dame Caroline Haslett for her services as chairman, Mr. S. F. Steward said that as well as being a great asset to the industry Dame Caroline was also a great public figure. The effects of her vision and courage were now being seen. Mr. C. R. King seconded the vote and Dame Caroline made a graceful reply.

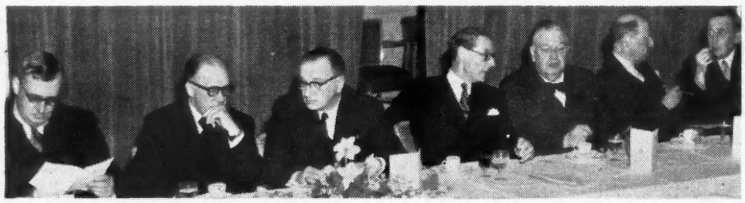
At a subsequent meeting of the Council Mr. S. F. Steward was elected chairman and Mr. C. R. King vice-chairman.

Sir Henry Self, Dame Caroline Haslett, Mr. Harold Bishop (president I.E.E.), Mr. Herbert Morrison, Mr. J. Henderson Stewart and the Viscountess Davidson

Mrs. C. T. Melling, Sir Joseph Hallsworth, Sir Thomas Bennett, Mr. J. Chuter Ede and Mr. C. R. King



Sir Giles Gilbert Scott, Sir Henry Hancock, Mr. E. Shinwell, Mr. S. F. Steward (the new chairman), Sir Harold Emmerson and Mr. J. R. Beard



Sir Alan Hitchman, Mr. A. Creech Jones, Mr. W. S. Lewis, Mr. D. D. Walker, Mr. L. Howles, Sir John Elliott and Mr. Leslie Gamage

E.A.W. CONFERENCE

"Electricity and the Countryside" is the theme of the twenty-ninth annual conference of the Electrical Association for Women which about 600 delegates from all parts of the country will be attending at Torquay from 17th to 20th May. The background to the subject will be given by Mr. S. F. Steward, C.B.E., chairman of the South Western Electricity Board, at the opening session in the Town Hall on 18th May, and particular aspects of the subject will be outlined by Lady Carew Pole, chairman, Electricity Consultative Council; by Mrs. Trump, a farmer's wife; and by Mrs. Carrie, a farm director. The special application of electricity to horticulture will be described by Dr. Daphne Vince, of Reading University.

"Women and the World" is the title of an address to be given on 19th May by the well-known author and playwright, Mr. St. John Ervine.

The Mayor of Torquay, Alderman P. T. Read, M.B.E., will give an official welcome to the delegates in the Town Hall on 18th May, and an official reception in the evening.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

THE Institution of Mechanical Engineers has announced that the James Clayton prize for 1953 has been awarded jointly to **Dr. T. W. F. Brown** and **Dr. A. T. Bowden.** Dr. Brown is the director of the "Pametrada" Research Establishment, Wallsend, and Dr. Bowden is chief research engineer at C. A. Parsons & Co.'s Heaton Works. Dr. Bowden has also been awarded the Thomas Hawksley Gold Medal, presented annually by the Institution for the best paper published in its "Proceedings." The awards are to be made to-day (Friday) at the Institution in London.

Mr. J. A. Brooks, B.Sc.(Eng.), has been appointed superintendent of the Motor Department of Metropolitan - Vickers Electrical Co., Ltd. Mr. Brooks was educated at Bournemouth Technical College and took an external degree at London University. After a college apprenticeship with M-V he served for a short time as welding sales engineer at the company's Birmingham office. In 1939 he joined the Techical (Engineering) Branch of the R.A.F., serving throughout the war and attaining the rank of squadron-leader. He became development engineer at the Leonard Works in 1946, but later moved to the Mosley Road Works. Here he was responsible for the layout and installation of the Heating Element Department, of which he eventually took charge. Returning to the Leonard Works in 1949, he was appointed assistant superintendent in 1950 and superintendent in 1952.

Mr. J. A. Brooks

Mr. L. E. Mold, O.B.E., M.I.E.E., has resigned from the board of A. Reyrolle & Co., Ltd., on reaching the retiring age. He joined the company forty years ago, and has been on the board for sixteen years.

Mr. G. J. Dodgson has been appointed secretary of A. Reyrolle & Co., Ltd., in succession to the late Mr. J. C. Arkless. Mr. Dodgson joined the company forty-four years ago and was deputy secretary for many years.

Sir Percy Mills, Bt., and **Mr. W. F. C. Schaap,** chief engineer, have been appointed to the board of Babcock & Wilcox, Ltd. **Lt.-Col. P. D. Ionides** has resigned from the board after twenty-six years' service. Sir Percy Mills is vice-chairman and managing director of W. & T. Avery, Ltd.

Mr. W. H. L. Hewitt, of the General Electric Co., Ltd., is joining the board of A. K. Fans, Ltd., as technical director as from 1st May. This is the first of major reorganizational changes which will be taking place. Pending completion of these changes a technical services division has been created for advice to all branches of industry, and, in the first instance, this service will be based at the company's head office at 20, Upper Park Road, London, N.W.3.

At a luncheon after a meeting of principal officers of the Midlands Electricity Board at Wolverhampton on 12th April, the chairman of the Board, Mr. W. S. Lewis, made a farewell presentation of a ciné-camera and a projector on behalf of himself and his colleagues to **Mr. D. H. Kendon,** who was deputy chairman of the Board until his appointment in February as chairman of the Merseyside and North Wales Electricity Board.

The British Welding Research Association has appointed **Mr. A. G. Thompson,** B.Sc., A.M.I.C.E., to make an investigation into welding productivity. Mr. Thompson has been associated with the welding and metal fabricating industries for a number of years and has recently been engaged in investigations into product design and production problems with a group of companies in the heavy engineering industry.

Sir Harry Pilkington, chairman of Pilkington Bros., Ltd., has been re-elected president of the Federation of British Industries for a second year of office.

The annual competition for apprentices and learners, organized by the Physical Society to encourage craftsmanship and draughtsmanship in the scientific instrument industry, produced one first prize winner, one third and one honourably mentioned entry from apprentices of Standard Telephones & Cables, Ltd. **Donald N. Frakes,** the first prize winner, submitted a power hacksaw model.

Mr. L. S. Crutch

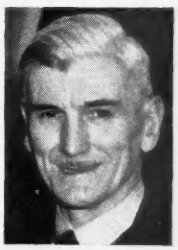
Mr. B. A. Hensler

Mr. F. W. H. Shaw

Mr. L. C. Bingham, general sales manager of Venner, Ltd., is leaving this country tomorrow (Saturday) by air for a two months' business tour of Australia, New Zealand and Malaya.

Mr. Leslie C. Gamage, vice-chairman and joint managing director of the General Electric Co., Ltd., has been re-elected president of the Institute of Export for the twelfth year.

Mr. J. P. H. Read, A.M.I.E.E., has been appointed chief engineer (machine section) of the Electric Construction Co., Ltd. Mr. Read joined the company in 1923 as an assistant machine design engineer, immediately after leaving Faraday House Engineering College, London. He succeeds Mr. W. J. Stay, whose retirement we recently reported. **Mr. F. S. Handley** has been appointed assistant chief engineer (machine section). He joined the company in 1908, receiving training in the armature shop and the fitting and brushgear departments from 1908 to 1912, and the test department from 1912 to 1919, when he was transferred to the machine design department as designs engineer for a.c. machines.



Mr. J. P. H. Read

Mr. W. H. Taylor, chairman and managing director of W. H. Taylor (Derby), Ltd., has been elected president of the Derby Electrical Society.

Siemens Brothers & Co., Ltd., announce the following appointments arising from organization changes recently made:—**Mr. L. S. Crutch,** general transmission manager; **Mr. B. A. Hensler,** general telephone manager; and **Mr. F. W. H. Shaw,** general cable manager.

It has already been reported that Mr. A. R. Cooper is the controller of the new **North Western, Merseyside & North Wales Division** of the B.E.A. (merging the North Western and Merseyside & North Wales Divisions), and Mr. P. Briggs, deputy controller.

The following further appointments have now been announced:—Mr. J. L. Ashworth, chief generation engineer (operation) of the North Western Division, takes up a similar position in the new Division. His deputy is Mr. R. S. Atkinson, at present chief generation engineer (operation) in the Merseyside & North Wales Division. Mr. C. R. Watson Smyth, who becomes chief generation engineer (construction), holds a similar position in the North Western Division, his deputy being Mr. W. H. C. Pilling, at present chief generation engineer (construction) in the Merseyside Division.

Mr. P. H. Flatt, secretary of the North Western Division, is appointed secretary of the new Division, with Mr. E. Butterworth (secretary, Merseyside Division) as his deputy. Mr. A. H. Campbell, the accountant of the new Division, is at present accountant of the Merseyside Division; his deputy is Mr. A. McLellan, accountant of the North Western Division.

Mr. A. V. Williams, A.C.G.I., B.Sc.(Eng.), A.M.I.E.E., has been appointed deputy chief engineer with Line Equipment, Ltd., Bridgend, Glamorgan, and will commence his duties on 1st May. Since 1948 Mr. Williams has been assistant engineer in the Technical Department of the British Electricity Authority, South Wales Division. His previous experience included training with the British Thomson-Houston Co., Ltd., and the English Electric Co., Ltd., in the switchgear erection and test departments; he also served as electrical lieutenant, R.N.V.R., and senior air electrical officer, R.N.A.S., during the war.

Mr. A. V. Williams

The Frigidaire Division of General Motors, Ltd., announces that **Miss Ann Smith** has joined its Sales Promotion Department as demonstrator and home economist. Miss Smith has specialized in food preservation by freezing, and has been a familiar figure at the Royal and many other Agricultural Shows. This year Miss Smith read a paper on Preservation of Food by Freezing at the annual conference of Electrical Housecraft Advisers.

Mr. T. D. Gregory, Ipswich manager of the English Electric Co., Ltd., is leaving this country early in May to take up an appointment as senior assistant in the New York office of the subsidiary company, the English Electric Export & Trading Co. At a recent meeting in Ipswich of the Ipswich & District Electrical Association, of which Mr. Gregory has been a member, he was presented with a cigarette lighter from the members. The presentation was made by the chairman of the Association, Mr. G. H. Blackburn. Mr. Gregory sails from Liverpool on the "Britannic" on 7th May.

Mr. R. H. Gummer, a director of International Combustion (Holdings), Ltd., has retired from active executive duties after nearly thirty years' service, but will remain a director of the company.

The Metropolitan-Vickers Electrical Co., Ltd., announces that on 1st April **Mr. R. H. S. Turner,** M.A., M.I.P.E., was appointed works manager, Trafford Park Works, and **Mr. A. Paterson,** B.Sc., A.R.T.C.(Glasgow), A.M.I.P.E., was appointed assistant works manager, Trafford Park Works.

Mr. Turner was educated at King's College School, Wimbledon, and St. John's College, Cambridge, and joined M-V for vacation training and a college apprenticeship course during 1930-32. After a period of erection work in the London district, he joined the Plant Department as a manufacturing engineer. In 1938 he transferred to the Instrument and Meter Department, becoming assistant superintendent two years later and taking charge of a shadow factory producing aircraft instruments. In 1944 he returned to the Plant Department in the same capacity, becoming superintendent in 1948, and assistant works manager, main works, in 1952. Mr. Turner is a vice-president of the Manchester Section of the Institution of Production Engineers, having been president for the period 1951-53.

Mr. Paterson was educated at Greenock Academy and served an apprenticeship with Scott's Shipbuilding & Engineering Co., Ltd. On leaving the Royal Technical College, Glasgow, he took a college apprenticeship course with M-V, and in 1930 joined the Motor Engineering Department. In 1935 he turned to motor manufacture, being superintendent's engineer until 1942, after which he became assistant superintendent, Motor Department, in 1942 and superintendent in 1945; in 1952 he undertook the additional responsibility of assistant works manager, Mosley Road Works (including Leonard Works).

Mr. R. H. S. Turner

Mr. A. Paterson

Mr. H. M. Mathews, C.I.E., M.I.E.E., has been appointed director of engineering of the English Electric Co., Ltd., responsible for co-ordination and direction of the technical policy of the company. Born in 1903 at Alverstoke, Hants, Mr. Mathews received his early education at the Wells House School, Malvern Wells and Cheltenham College, before proceeding to Faraday House for his electrical engineering studies. From 1924 to 1926 he was with the City of Winnipeg Hydro-Electric System and from 1927 to 1941 he was on the staff of Merz & McLellan, first as their representative on the construction of the Kalyan power station, India, then as their representative in Canada, and from 1933 to 1940, at their London office.

Mr. H. M. Mathews

From 1941 to 1948 Mr. Mathews was the Electrical Commissioner of the Government of India and from 1945 to 1948 he was also chairman of the Central Technical Power Board in India. He was created a C.I.E. in 1944.

Mr. Mathews joined the English Electric Co. in 1948 as adviser to the chairman and managing director, on whose behalf he has since travelled extensively, mainly in Australia, Africa, the United States, India and Turkey. He is a director of the English Electric Export & Trading Co., Ltd.

At the annual general meeting of the Batti-Wallahs' Society on 12th April, **Mr. C. N. Good** was elected president for 1954-55. The six elected members of the committee are Dr. L. G. Brazier, Messrs. M. D. Cloran, W. C. M. Couch, C.B.E., H. A. Crabtree, A. N. East, C.B.E., and G. H. L. Smith. Mr. T. C. F. Bigland was re-elected hon. secretary and treasurer and Mr. J. Temple Hazell was re-elected assistant hon. secretary.

Mr. E. Hartley Leather, M.P., was the guest speaker at the monthly luncheon of the **Electrical Industries Club** on 13th April, when Mr. A. B. Wildsmith, the Club chairman, presided. Mr. Leather's speech was devoted largely to the economics of this year's Budget. The next luncheon will be held on 11th May.

Mr. **M. D. Mossman** has been appointed manager of the South Wales Branch of the Machinery Division of George Cohen, Sons & Co., Ltd. Mr. Mossman joined George Cohen's Stanningley, Leeds, depot in 1937, and moved to Swansea in 1941, where he became head of the company's Contractors' Plant Department in South Wales.

Mr. **R. A. Yapp,** a director and sales manager of Bepco Canada, Ltd., and a former L.D.C. apprentice, received a gold watch as a long service award from the hands of Mr. D. C. Lorkin, joint managing director of Lancashire Dynamo & Crypto, Ltd., during the recent annual dance held by the Willesden works. Mr. Lorkin also presented a similar award to **Mr. F. H. Schroeder,** sales director of L.D.C. A number of employees also received gold watches to mark the completion of twenty-five years' service. Mr. Schroeder presented watches for long service to two employees of Crypto, Ltd. More than 700 people attended the dance, including contingents from the L.D.C. works at Irchester and from Crypto, Ltd.

Mr. A. R. E. Arnot, B.Sc.(Eng.) Hons., A.M.I.E.E., and **Mr. R. G. Winton,** A.M.I.Mech.E., A.M.I. Prod.E., have been appointed to the board of Lansing Bagnall, Ltd. They have been with the company for many years.

Mr. Arnot was educated at St. Paul's School. He served an apprenticeship with Ultra Electric, Ltd., studying electronics, and then

Mr. A. R. E. Arnot

Mr. R. G. Winton

a post-graduate student apprenticeship with the B.T.H. Co., Rugby. He joined Rubery Owen Messier as research engineer on aircraft hydraulics, and later became special products engineer to Rotax, Ltd., designing electro-mechanical equipment. In 1944 he became associated with Lansing Bagnall, Ltd., and is now a director and chief engineer.

Mr. Winton was with the London Passenger Transport Board for a number of years before he became lecturer in production engineering at Northampton Polytechnic and at Twickenham Technical College, where he initiated higher national certificates in production engineering and allied subjects. Seven years ago he joined Lansing Bagnall, Ltd., as technical manager. As the only British member of the O.E.E.C. Mission of materials handling experts, he was one of the Western European engineers who studied U.S.A., Canadian and European materials handling equipment and methods in visits to these countries.

Mr. H. P. Mott (chairman of the Institute of Materials Handling) has joined the staff of Lansing Bagnall, Ltd., as materials and production controller. He is well known for his experience in materials handling with Vauxhall Motors. He is an associate member of the Institute of Production Engineers.

The final of the **Cable Makers' Association** Football Cup Competition was played on the grounds of British Insulated Callender's Cables, Ltd., Belvedere, on 10th April. The winners of the northern zone, British Insulated Callender's Cables, Ltd., Prescot, beat the winners of the southern zone, Southern United Telephone Cables, Ltd., by 2 goals to 1. Callender's Senior Band, conducted by Mr. C. A. Waters, provided a programme of music. In the evening the members of the twenty teams which had participated in the competition met for dinner at the Holborn Restaurant, London, when the trophy and medals were presented by Mr. F. Waine (B.I.C.C.). The dinner was followed by a cabaret.

The amateur boxing section of the Sports Club of the **Telegraph Construction & Maintenance Co., Ltd.,** held its last tournament of the season on 12th April at Telcon Works, Greenwich. There was an attendance of over 600. The prizes were presented by Mr. F. Leighton, general works manager and president of the Telcon Social and Athletic Club.

Mr. H. P. Mott

A parents' day was recently held at the Derby Works of **International Combustion, Ltd.,** which was attended by over 300 relatives and friends of the 180 boys in the apprentice training scheme. The visitors were shown round the various workshops. The arrangements were made by the apprentices, under the guidance of departmental heads, and culminated in a general meeting in the main canteen where, during tea, directors and senior officials met the visitors and answered their questions. An exhibition of the apprentices' work was also arranged.

Mr. W. E. Warrilow, M.I.E.E., and Mrs. Warrilow sailed on 15th April for New Zealand, where they are to settle with one of their daughters and her husband. Mr. Warrilow's New Zealand address will be P.O. Box 647, Hamilton.

OBITUARY

Mr. T. N. Dunn, service department manager of Bulpitt & Sons, Ltd., died on 12th April at the age of fifty-two. Mr. Dunn joined the company's electrical department in June, 1929.

Mr. W. Stearn, senior representative of the Ediswan Southampton district office, died in hospital on 24th March. Mr. Stearn had been a member of the Ediswan organization since 1922. He was president of the Electrical Industries Benevolent Association for Hampshire and Dorset and was a founder member and match secretary of the South Hants Electrical Industries Golfing Association.

Mr. L. E. White, district engineer at the Erith Contracts office of British Insulated Callender's Construction Co., Ltd., died on 28th March, at the age of fifty-five. Mr. White joined the old Callender's Company as a pupil apprentice in 1915.

Mr. G. W. Cooper.—The death has occurred of Mr. George William Cooper, chief electrical engineer at the Devonshire works of the Staveley Iron & Chemical Co., with which he had been associated for thirty-five years.

Mr. A. H. M'Kay, A.M.I.E.E., mains superintendent with the Aberdeen Corporation Electricity Department until his retirement in 1944, has died. He joined the Department in 1899, and played a major part in the electrification of the city's tramway system.

Mr. C. H. Downing.—The death occurred recently of Mr. Charles H. Downing, of Downing & Partners, Putney.

WILLS

Mr. C. F. Cogswell, secretary of Philips Electrical, Ltd., who died on 28th December, left £13,842 gross (£13,522 net).

Mr. J. Marshall, managing director of R. E. & C. Marshall, Ltd., electrical contractors, who died on 20th December, left £64,680 gross (£62,641 net).

French Illumination Study

The French Association of Illuminators organizes each year several " Days for the study of illumination," during which it discusses improvements of the sources of light and their various applications. This year, on the invitation of the Municipality of Monaco, the Illumination Days of the A.F.E. will take place from 8th to 12th June in the Principality under the patronage of H.S.H. the Sovereign Prince of Monaco and under the presidency of Professor Y. le Grand, president of the Association. A programme of illuminations is in course of preparation and the installations prepared for the Congress will remain during the summer season.

INDUSTRIAL NEWS

Further Increase for Electricians

AN AWARD OF an increase of ½d an hour has been made by an Industrial Disputes Tribunal to employees in the electrical contracting industry from 15th March. This is additional to the 2d an hour granted by the National Federated Electrical Association last month.

Increased Coal Prices

Last week the National Coal Board announced all-round increases in the pithead prices of coal to take effect from 3rd May. On all inland coal the average increase will be 2s 10d a ton or about 4·8 per cent. The price of coal supplied to the electricity supply industry will rise by 1s 5d a ton, the price of gas coal by 3s, and that of general industrial and other inland supplies by 2s.

The Board announced, in 1951, its policy of basing coal prices on calorific value and it says that, subject to this basic conception, it is further developing in the new prices a policy of relating the prices of individual classes of coal to supply and demand and of having regard to special scarcities, for example, in the case of all large coal.

The Board further announces that its members and national officials of the National Union of Miners met on 13th April to review the steps already taken to improve output. They agreed to meet again in a few weeks' time to make a further review.

Lighting in Mines

Mr. J. Davis, Inspector to the Philadelphia and District Mines Inspection Board, Co. Durham, in his quarterly report, called for better lighting in mines, and asserted that the number of mining accidents could be reduced if the lighting regulations were carried out. He stated that at one colliery fluorescent lighting had been installed on a coal-face 100 yd long and it was possible to stand at one end of the face and see every man at work. This contrasted with other pits where the lighting even at shaft bottoms and main shaft sidings was very poor. Mr. Davis agreed that the shortage of suitable flameproof equipment was delaying the installation of electric lighting equipment.

Shrewsbury Electrical Exhibition

Since the Midlands Electricity Board was established six years ago the number of farms in Shropshire and Herefordshire supplied with electricity has been doubled. This was stated by Mr. W. S. Lewis, chairman of the Board, when speaking at the opening of a three-day exhibition arranged by the Electricity Board at Shrewsbury to show local authorities and others the contribution that the electricity supply industry could make to the solution of housing and other problems. During the coming year, he said, capital expenditure in the Board's area would amount to £6,300,000 of which £820,000 would be for rural development. Referring to the fact that the first atomic energy station was now being built and that electricity was the only known method of distributing that future potential source of energy, Mr. Lewis said the area hoped to get one of the small scale plants in a few years' time. It would make a tremendous difference in view of the rise in the cost of coal.

Opening the exhibition, Major-General Lord Bridgeman, Lord Lieutenant of Shropshire, said that three things were necessary (and he did not place them in any special order) if they were to maintain the population of the countryside: they were water, transport and electricity. Electricity was to-day the lifeblood of agriculture and industry, and perhaps to-morrow it would also be the lifeblood of traction.

Welding Research

The new research and development laboratories of the Quasi-Arc Co., Ltd., were opened at Bilston, Staffs., recently, by Mr. J. S. Hutchison, chairman of the British Oxygen group of companies. The laboratory block is a single storey structure providing a floor space of about 8,500 sq ft and has been designed to enable a second storey to be added at a later date.

At present there are eight main laboratories, together with attendant offices, dark rooms, metallographic preparation room, balance room, stores, electrical switchroom and cloakrooms. The work which is being carried out covers electrode development, chemical analysis, spectrographic analysis, mechanical testing, physical testing, metallography and petrology, X-ray diffraction and radiography.

Fatality

A verdict of "Death by misadventure" was recorded by the Rotherham coroner at an adjourned inquest at Dinnington on Mrs. Kathleen Mellors, of Letwell, near Worksop, Notts., who received a fatal shock while using a vacuum cleaner. A Yorkshire Electricity Board engineer who examined the cleaner said a three-wire cable on the cleaner was connected to a two-pin plug and the earth wire had been attached to one of the pins on the plug. The coroner said it would have been more satisfactory to have found out when and by whom the plug had been wired in such a manner. The evidence had not disclosed these facts but obviously there had been no criminal negligence.

El Salvador Market

The British Legation at San Salvador has notified the Export Services Branch of the Board of Trade that it is expected that the hydro-electric installations at Guayabo on the Lempa River will begin working in June or July. Their capacity is estimated at 45,000 kW and this increase in available electric power will undoubtedly create a bigger market for domestic electrical appliances: cooking-stoves, refrigerators, air-conditioners, kettles, toasters, etc. (but not electric heaters because the climate is too hot for these to be necessary). It is suggested that United Kingdom manufacturers of these appliances will wish to check that their arrangements for covering the El Salvador market are such as will make the most of the opportunity offered by this development.

Industrial Safety Conference

The National Industrial Safety Conference organized by the Royal Society for the Prevention of Accidents will be held at the Spa Theatre, Scarborough, from 14th to 16th May.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £156 0s 0d
COPPER, H.C. Electro	ton £249 0s 0d
Fire Refined 99·70%	ton £248 0s 0d
Fire Refined 99·50%	ton £247 0s 0d
COPPER Tubes ..	lb 2s 4½d
Sheet	ton £304 5s 0d
H.C. wire and strip	ton £276 0s 0d
LEAD, English ..	ton £97 10s 0d
Foreign	ton £96 0s 0d
MERCURY	flask £80 0s 0d
TIN, block (English) ..	ton £815 0s 0d
ZINC, G.O.B. Foreign	ton £80 0s 0d
Electrolytic	ton £88 0s 0d
BRASS Tubes (solid drawn)	lb 1s 11⅞d
Sheet	ton £249 0s 0d
Wire	lb 2s 6½d
PHOSPHOR BRONZE Wire	lb 3s 10½d
PLATINUM	oz £30 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 18d–18½d

Vehicle Lighting Regulations

Existing rules about the size and position of rear lamps and reflectors on road vehicles are being revised by the Minister of Transport and Civil Aviation, as a result of the passing of the Road Transport Lighting Act, 1953.

This Act requires pedal cycles and solo motor cycles to have a reflector as well as a rear lamp and nearly all other vehicles to have two lamps and two reflectors instead of a single lamp, as at present. The proposed new rules for reflectors apply to all vehicles from 1st October, 1954. Those for rear lamps will be brought into operation in the following three stages:—New vehicles, from 1st October, 1954; existing pedal cycles and tricycles (including motor-assisted cycles not exceeding 50 c.c. engine capacity), from 1st October, 1955; all other existing vehicles, from 1st October, 1956. Although regulations have not yet been made, specifications, one for reflectors and one for lamps, are being made available to manufacturers.

Government Broker for Copper

The Ministry of Materials announces that, as from 31st May next, the Government broker for copper will cease to operate. The Ministry considers that by the end of May consumers will have had adequate opportunities to make their own supply arrangements and there should no longer be any need for official support of the market.

Large Creep-Resisting Forging

William Jessop & Sons, Ltd., have recently produced what is believed to be the largest forging ever made in a creep-resisting steel. The material is Jessop H.46, a ferritic steel with about 12 per cent chromium and other additions that have found extensive applications in the production of rotor discs of the latest gas-turbine engines for British aircraft. The forging in question is a shaft some 8 tons in weight, 14ft long and 35in in maximum diameter. It is to be used as the rotor in a large Continental gas-turbine generating plant.

Projection Welding

The latest addition to the series of technical booklets issued by the British Welding Research Association, 29, Park Crescent, London, W.1, is entitled "Projection Welding of Mild Steel." It covers all aspects of projection welding and is the first available in Great Britain dealing solely with this subject. Recommendations are made covering machines and electrodes, materials to be used, types of projections, etc., and all are prepared from a series of extensive researches conducted by the B.W.R.A. The booklet concludes with a section on suggested practices for projection welding based on present industrial experience.

Management Conference

A management conference for the north-west was held on 2nd and 3rd April by the British Institute of Management, in conjunction with the Federation of British Industries, the National Union of Manufacturers, and the Merseyside Branch of the Institute of Industrial Administration. Papers were given on "Working Capital Needs and Replacement Costs," by Mr. A. R. English, "Incentives—Stimulating the Will to Work," by Mr. T. A. Mason, two papers on "Variety *v.* Economy Production—A Management Dilemma," by Mr. D. H. P. Braid and Mr. A. Ormerod, "Training for Management in the North-West," by Major G. Jenkins, and "Breaking into the Dollar Market," by Mr. G. L. G. Jackson.

Marine Radio Equipment for Canada

The Marconi International Marine Communication Co., Ltd., has received an order through the Canadian Marconi Co. to supply radio communication equipment and aids to navigation for the 12,400 ton bulk alumina carrier under construction at the Lauzon, Quebec, yard of Davie Shipbuilding, Ltd. The vessel is being built for Sun Steamship, Ltd., and has been bareboat chartered to Saguenay Terminals, Ltd., of Montreal. The equipment will consist of an "Oceanspan" main transmitter, "Reliance" auxiliary and emergency transmitter, "Mercury" and "Electra" receivers and an automatic keying unit.

A "Seagraph" recording echometer and a "Lodestone" long-range direction-finder are to be supplied to aid navigation, while a "Vigilant" auto-alarm will be installed for safety of life at sea purposes. The installation will be carried out by the Canadian Marconi Co.

Photography in Industry

The Federation of British Industries has issued a booklet, "Photography in Industry," the fourth of a series of public relations booklets. The booklet is prepared for those firms that do not possess their own specialists in public relations. After touching briefly on technical points, it describes the part of photography in industrial public relations, sales promotion and internal relations.

Floating Trade Exhibition

Thurgar Bolle, Ltd., are arranging an exhibition on board the M.Y. *Thurgar*, which will be moored on the Thames at Westminster during the month of May. A feature of the display will be plastic mouldings in the newer materials which will include electrical insulators, etc.

Works Visits

A visit was paid recently to the Strowger (Liverpool) works of the Automatic Telephone & Electric Co., Ltd., by Mr. G. R. B. Patterson, Senior Trade Commissioner for Australia, Mr. D. J. Muir, Agent-General for Queensland, the Hon. Sir John Lienhop, Agent-General for Victoria, the Hon. J. A. Dimmitt, Agent-General for Western Australia, and Mr. H. Greenham, Agent-General and Trade Commissioner for South Australia. The visitors were accompanied around the works by Mr. F. C. Burstall, deputy managing director of the Automatic Telephone & Electric Co., and amongst the equipment inspected was a private automatic telephone exchange in course of manufacture for Australia.

On 8th April over 200 members of the Institution of Locomotive Engineers visited the main works of the British Thomson-Houston Co., Ltd., at Rugby. The programme included visits to the turbine factory, heavy plant factory, fabrication department, the industrial electronics factory and the "Mazda" lamp works. Three diesel-electric locomotives were available for examination and the "Clearcall" carrier frequency communication equipment developed for British Railways formed another interesting exhibit.

Electric Irons

In our survey of electric irons on 9th April we inadvertently omitted the address of the Scottish Precision Engineering Co., Ltd., makers of the "Rob Roy" apparatus. The address is 27, Cadogan Street, Glasgow, C.2.

Trade Announcements

The heating and welding activities of the **Metropolitan-Vickers Electrical Co., Ltd.,** have been further co-ordinated. As from 1st April, the engineering sections dealing with all forms of h.f. heating (induction furnaces, dielectric heating, etc.) as well as resistance heating using sheathed tubular elements have been combined with the Welding Engineering Department, under its chief engineer, Mr. C. F. Saunders.

In pursuance of the plan to consolidate the activities of the Parkinson & Cowan group of companies, the electrical division of **Measurement, Ltd.,** will be transferred on 30th April to Parkinson & Cowan, Ltd., the parent company. On the same date Aspec (London), Ltd., will be liquidated and will cease to trade as a separate limited company. From 1st May, the Electrical Division and Aspec will be merged and will operate as a new division of Parkinson & Cowan, Ltd., under the title Parkinson & Cowan Instruments (Incorporating Aspec). It is emphasized that these changes are a matter of internal reorganization only.

G.B.M. (Electrical) Birmingham, Ltd., has appointed Mr. J. H. Shirley its London representative. A new stock room has been opened at 46, Cornwallis Road, London, N.9 (telephone: Tottenham 7427), providing immediate delivery of oil filled radiators and immersion heaters.

On 29th April the offices of **Chemical Engineering Wiltons, Ltd.,** a subsidiary of Simon-Carves, Ltd., will be transferred to Cheadle Heath, Stockport, Ches. (telephone: Gatley 5231).

The **Scottish Machine Tool Corporation, Ltd.,** now has a Birmingham and district office at 2, Sir Harry's Road, Edgbaston, Birmingham, 5 (telephone: Calthorpe 2541).

Ekco-Ensign Electric, Ltd., has appointed Mr. J. G. Goodwin as its representative covering Derbyshire and the Western Section of Nottinghamshire. He will operate from the company's East Midlands sales office at 57, Hounds Gate, Nottingham.

Safe Use of Portable Equipment

RECOMMENDATIONS for securing safety in the use of portable and transportable electrical equipment in industry were made by Mr. J. W. Bunting (Courtaulds, Ltd.) in a paper presented yesterday (Thursday) evening before the Utilization Section of the Institution of Electrical Engineers.

The term " portable " referred to equipment suitable for carrying in the hands and " transportable " to equipment moved on wheels; the former introduced greater shock risks. Two-thirds of electrical fatalities (1951) occurred at voltages below 250 and four-fifths of these were associated with portable equipment. Faulty earthing was responsible for 79 reportable accidents, of which 13 were fatal, all due to portable or transportable apparatus, which accounted for more than a third of 530 non-fatal accidents.

Two kinds of shock could be fatal at low voltage. The first was from muscular contraction in which more than 15 mA through the wrists might prevent release and possibly extend to chest muscles and cause death by asphyxia within two or three minutes; artificial respiration was often effective. The second was associated with ventricular fibrillation in which normal pumping action of the heart ceased and this condition, once established, was not susceptible to first-aid treatment. If the duration was of 1 sec or more, 100 mA was the maximum safe current through the chest, but with limitation to 0·03 sec 1·5 A would probably not be dangerous, although accompanied by violent muscular reactions and severe burns. A minimum body resistance was taken of 1,000 ohms from hand to hand or from hand to feet, the figure varying with health, wet or dry skin, contact areas and pressure, applied voltage and duration of shock.

In general the lower the voltage the higher the resistance, chiefly because of the less likelihood of the shock causing sweating or blistering of the skin. At 240 V and 1,000 ohms the current of 240 mA might be enough to result in fibrillation if sustained for more than a fraction of a second. At 110 V, the 110 mA passed could have similar effects if prolonged and even at 50 V the shock through wet hands could be unpleasant, but 12·5 V was safe under any conditions.

Neither earthed- nor unearthed-neutral systems were altogether satisfactory, the former being better for 415 V three-phase installations. The neutral should be bonded to a copper strip laid round the factory as a ring which could be earthed at other points. Supplies to handlamps should be at 25 V (12·5 V to earth). A double-wound transformer with the mid-point of its secondary 50 V winding earthed would require no earth core in its flexible cable, but was suitable only for low-power applications and lighting. Portable tools at 50 V averaged in weight only $\frac{1}{4}$ lb more than at 240 V and were 5 per cent less efficient. These tools should be operated, however, within 5 per cent of their nominal voltage and the restriction of the 2·5 V drop necessitated individual local or (undesirably) portable transformers.

For operating at 110 V with midpoint earthed, circuits were described that were designed to cope with faults which occurred when the earth core of the flexible cable was intact and when broken, including the well-known Butcher method.

For the heavier transportable equipment operated at 415 V earth monitoring devices were described; these had their earth circuits so interlocked electrically with the supply as to prevent it being switched on or maintained unless earth and auxiliary earth cores through the flexible cables were intact and properly connected. The auxiliary earth connection included the trip coil of an earth-leakage circuit breaker, which operated if a fault voltage in excess of 20 V to earth appeared on the frame of the protected equipment. Finally, good maintenance, with careful records of insulation and earth resistances, was essential.

Electrical Indicating Instruments

THE British Standards Institution has recently published a new edition of B.S. 89, " Electrical Indicating Instruments," covering ammeters, voltmeters, wattmeters, frequency indicators and power factor indicators. The last edition was issued in 1937 and in carrying out the present revision opportunity has been taken to bring the specification more into line with present-day practice, both in the design and in the use of instruments. At the same time due regard is paid to developments still in progress by deliberately making some requirements, e.g., those relating to construction of scales, not too rigid.

The two classes of instruments now recognized are precision instruments and industrial instruments; the former having emphasis on accuracy and the latter on robustness. The specification falls into a number of sections which cover ratings, construction, marking, tests, limits of error and variation of indication. Limits of error are generally expressed as a percentage of scale range, allowance being made for the greater accuracy which one may expect from the instruments having longer scale lengths. Some allowance is made for the different conditions of use between industrial switchboard instruments and industrial portable instruments, and special consideration is given to ammeters which require extended scales to allow for momentary overloads.

Tables are given of preferred ranges for ammeters and voltmeters, and of permissible variations in indication due to changes in temperature of the surrounding air, to external magnetic field, change in frequency, to being left in circuit, etc. The section on marking indicates the information to be given with each instrument but to maintain clarity of scale reading, differentiating between that which must be visible from the front and that which must be visible from the outside but not be obtrusive. Tests are dealt with in detail and include high-voltage tests and damping times. Extensive appendices, while not mandatory, give valuable information on the interpretation of the specification and recommend dimensions of instrument cases, shunts, letter symbols and graphical symbols.

As mentioned in the foreword to the specification, the accuracy laid down in the standard does not in any way represent the highest degree of accuracy which can be obtained with British instruments. Greater accuracy can be provided by arrangement with manufacturers, but the limits given in the specification represent good working values to satisfy the general requirements of both maker and user.

Copies of the standard may be obtained from the British Standards Institution, Sales Branch, 2, Park Street, London, W.1, price 7s 6d.

SCIENTIFIC INSTRUMENTS

Trends in Design Portrayed at the Physical Society Exhibition

THE Physical Society's 38th annual exhibition of scientific instruments and apparatus was opened on Thursday, 8th April, by Professor R. Whiddington, C.B.E., M.A., D.Sc., F.R.S., at the Imperial College, South Kensington, and remained open until 13th April. This year, the exhibition was confined to the one building, and because of the space restrictions the number of firms and establishments exhibiting had to be severely limited (there were, in fact, only 103 stands in the exhibition). An innovation resulting from this was a section of the catalogue devoted to apparatus which had in consequence been excluded.

On 8th April Professor F. Llewellyn Jones, of the University College of Swansea, University of Wales, gave a discourse on "The Electrical Contact." He chiefly concerned himself with the microscopic molten metal bridge which is formed during the opening of a pair of contacts, even at very moderate voltages. The current density through the bridge can easily be of the order of 10^7 A/sq cm, and the temperature is effectively dependent only upon the voltage across the contacts. Thus even the boiling point of platinum (4,300 deg C) is reached with the application of only 1·43 V.

The location of the small region of the bridge where boiling occurs is determined by thermoelectric effects, electrical polarity and, in the case of dissimilar metal contacts, their resistivities. When it occurs, the bridge breaks, and a microscopic pip is produced in one electrode and a crater in the other. After repeated operation, the size of these increases until the contacts are rendered useless. Professor Llewellyn Jones demonstrated the molten bridge, and photographs, etc., were on view on the University College, Swansea, stand in the exhibition.

A demonstration-lecture was given by Mr. Walter Lawrence, B.A., A.M.I.E.E. (Signals Research and Development Establishment) on "An Artificial Talking Device" in which a photo-electronic controller produces signals following profiles painted on a glass slide, which are combined to form intelligible speech. An estimate of the total bandwidth required to transmit speech in this form is less than 150 c/s. The Acoustics Group of the Physical Society arranged a symposium on "The Analysis, Synthesis and Recognition of Speech." Papers read included "The Parameters of Speech," "Measurement of Intelligibility of Speech Links," and "The Experimental Synthesis of Speech from Parameters." A discourse was given by Professor Tolansky (Royal Holloway College, University of London) on "The Study of Surface Topology by Optical Methods."

Prevalence of Electronic Equipment

In the exhibition, as in previous years, electronic equipment prevailed in almost every field, and instruments employing cathode ray tube presentation confronted one on all sides. Among oscillographs a double beam instrument was shown for use at frequencies from 15 c/s–3·5 Mc/s capable of being operated from a wide range of supply voltages and frequencies. Another manufacturer showed an oscillograph based on a four-gun tube, together with oscillograph recording cameras and a machine which completely processes lengths of recording paper up to 120 mm width at a speed of 1·25in/sec without the necessity for darkroom facilities. Another oscilloscope has a flat response from 30 kc/s to 20 Mc/s and a rise-time of 25 mμsec, utilizing a flat faced tube mounted vertically and viewed through a surface aluminized mirror. Direct-coupled amplifiers on other instruments give bandwidths from d.c. to 4 Mc/s and 6 Mc/s respectively. A high-speed transient oscilloscope for triggered operation with a response from d.c. to 25 Mc/s and a range of double gun oscilloscopes were described in the non-exhibitors' section of the catalogue. In some triggered instruments delay systems are incorporated, permitting the detailed examination of small portions of the waveform. A range of flat faced cathode ray tubes was shown which included single, double and quadruple guns, a high writing speed type, and square faced tubes.

Oscillators were also exhibited in large numbers. A high stability variable oscillator for transmitter excitation in the high frequency band dispenses with quartz crystals, with their limitation of fixed frequency: a high precision variable capacitor, a stable inductor and a temperature-compensating capacitor network, connected in an electron-coupled Hartley circuit, are enclosed in an oven. With the temperature controlled to $\pm$ 1 deg C the frequency is maintained within the 24-hour 0·003 per cent limit of the International Telecommunications Union. The oscillator frequency is variable between 1–1·7 Mc/s, and the second or third harmonic is selected and amplified, giving an output of $\frac{1}{2}$ W at 2–5·1 Mc/s.

Other oscillators include an instrument covering the frequency ranges 3·4–6·9 Mc/s and 2·25–5·5 Mc/s with high accuracy and good setting accuracy; an amplitude stabilized LC oscillator covering the range 10 kc/s–10 Mc/s and, in addition, fixed frequency square and sine waves at 50 c/s; and a low frequency oscillator covering the frequency range 1·4 c/s to 15 kc/s with output constant within $\pm$ 1dB down to 5 c/s and low harmonic content. A transportable oscillator for use under field conditions in any climate has a carrier frequency range of 85 kc/s–32 Mc/s which can be amplitude modulated at all frequencies or frequency modulated above 2 Mc/s at 1 kc/s, and a similar instrument for the range 20–80 Mc/s can be amplitude or frequency modulated at 1 kc/s over the whole range. A v.h.f. signal generator is continuously variable from 96–160 Mc/s, and can be modulated at 30 c/s–10 kc/s, internal 1 kc/s modulation being provided, with facilities for using an external crystal frequency between 1 and 10 Mc/s, and motor-driven tuning.

One exhibitor showed a low frequency decade oscillator, frequency range 0·1 c/s–11·1 kc/s, which can be extended to special order down to 0·01 c/s, with four-phase output. The 0 deg and 180 deg outputs feed an attenuator network giving an output of from 10 V down to 10 mV or 20 mV balanced. It is intended for use with a phase-sensitive voltmeter covering the range 0·5 c/s–1 kc/s which indicates the "in phase" and "quadrature" components of an applied test voltage. A similar instrument for the range 20 c/s–20 kc/s contains an internal reference voltage. These reference and signal inputs are fed through channels of wide-band amplification to thermocouple type wattmeters. Applications include the plotting of Nyquist diagrams of servo mechanisms, feedback amplifiers and passive networks, the testing of transformer cores and as a bridge balance detector and detector for a.c. strain gauge systems.

Other valve voltmeters included a portable battery-operated a.c./d.c. diode voltmeter, a feedback voltmeter in which changes in the rectification ratio of the meter rectifiers are minimized, an instrument covering the range from d.c. to 300 Mc/s, and another measuring voltages between 100 μV–1 kV in the frequency range 10 c/s–10 Mc/s with logarithmic voltage scale, the amplifier of which can be used separately.

An amplifier designed for valve voltmeter operation with substandard accuracy has high long-term gain stability and linearity with low distortion and phase shift as a result of overall negative feedback of the order of 700 : 1. An amplifier detector with an accurately calibrated frequency range of 30 c/s–30 kc/s can be used selectively, with 36 dB harmonic suppression, or as a flat-response amplifier. A bandwidth of 80 Mc/s and a rise time of 8 mμsec are features of a distributed amplifier, the input and output impedances of which are 75 Ω and 200 Ω, the gain 13 and the maximum output 150 V.

A rugged magnetic amplifier gives an output of 5 mA into a 500 Ω load for 4 mV input. In another instrument d.c. amplification is obtained by the use of a vibrating condenser unit mounted on a standard octal base and a phase sensitive detector, with normal stages of a.c. amplification between.

Voltage and Frequency Regulation

Methods employed to obtain stabilized supplies include auto-transformers driven by servomotors fed by the error voltage to provide a stabilized a.c. output; and purely electronic stabilization of a dual d.c. supply, the two identical but separate outputs of which, stabilized over the range 120–420 V at 0–250 mA, can be used individually, combined in series or in parallel, or combined to give a supply swinging from positive through zero to negative. A comprehensive range of a.c. and d.c. regulators utilizes the out-of-balance voltage from a bridge, one arm of which is a tungsten diode with heater supply from the output, to control a beam tetrode and thence a saturable reactor. Another voltage stabilizer utilizes a constant-voltage transformer with a simple electronic circuit compensating for any necessarily slow variations in frequency and load power factor.

Frequency standardizing equipment exhibited consists of a chain of multivibrators and a 1 kc/s crystal oscillator, synchronized from the B.B.C. 200 kc/s transmission, which makes available nine standard frequencies between 1 c/s and 200 kc/s. A frequency synthesizer provides any multiple of 1 kc/s to 100 Mc/s as a result of mixing pairs of frequencies and filtering out unwanted components, a narrow range oscillator filling in the gaps and giving continuous frequency coverage.

An automatic frequency monitor comprises a crystal controlled frequency, divided to control the open time of an electronic gate to 0·1 sec, 1 sec or 10 sec. The frequency to be measured passes through the gate into a 7 decade scaler, enabling frequencies from 10 c/s to 10 Mc/s (extended by frequency division to 20 Mc/s) to be measured. A similar principle is employed in two electronic tachometers in which the signal is derived from some suitable pick-up. In one case the gate can be open for from 0·1 sec to 20 min, derived from the 50 c/s mains; in the other case it is open for 1 sec, derived from a crystal oscillator, and the visual display is renewed every second.

A portable engine indicator contains electromagnetic transducers giving cathode ray tube presentation of pressures and movement. The time base is locked to the engine speed and the crankshaft position corresponding to a given distance along the time base is ascertained by means of a stroboscopic lamp synchronized with a " pip " on the trace. In another instrument the frequencies of vibration and noise from rotating machinery are compared with that of one of the rotating shafts, harmonic relationship being indicated by the lighting of a neon tube.

Various patterns of transducers were exhibited, including unbonded wire types, and thin metal foils etched into a variety of strain-sensitive patterns and mounted with lacquer backing. In the load cell a high tensile steel member with resistance wire strain gauges bonded to it is stressed by the force to be measured. The resultant bridge unbalance is linear in relationship with the load. Maximum ratings of $\frac{1}{2}$ ton to 200 tons are available.

A new type of protective remote control circuit for mining switchgear was shown, employing a combination of sequential relays and a remotely placed pilot switch connected by a single pilot conductor with earth return. A ventilation network calculator simulates by means of 60 linear variable resistors and four power packs the airways and fans in a mine. Satisfactory accuracy is obtained in three or four stages of approximation.

A radio altimeter with an accuracy of $\pm$ 10ft at 200ft and 3 per cent of indicated height up to 5,000ft was shown. A continuous wave is radiated, whose frequency varies in a sawtooth manner. Elsewhere an aircraft stall detector and pitch attitude indicator were shown, together with a fishing echo sounder with cathode ray tube presentation. Other applications of ultrasonics included flaw detection, thickness measurement, cleaning, the drilling of irregular-shaped holes in brittle material, and medical diagnosis.

Components and equipment for the S- and X-bands (9–11 cm and 3–3·55 cm respectively) were displayed on many stands, and included complete waveguide test benches for the X-band, single and double vane torque-operated X-band wattmeters, a Q meter for resonant cavities in either band, precision attenuators, crystal receivers, cavity wavemeters and a microwave band pass filter. Two firms exhibited instruments for recording the radiation patterns of microwave antennæ.

Materials and techniques exhibited included various ceramics and ferrites, synthetic quartz for oscillator plates, conducting and semi-conducting glass films, and " potted " and printed circuits. Several companies showed transistors, including a point contact type capable of operation up to 40 Mc/s. Semi-conducting intermetallic compounds were shown which may prove useful in rectifiers and photocells, and may lead to transistors which can be operated at higher frequencies and temperatures.

Ranges of Geiger-Müller, scintillation and boron trifluoride neutron counters were shown. Binary and decade counting and scaling units included an equipment built on the unit principle so that as many decades can be incorporated as are required for any given application. A pulse analyser will handle fast or slow pulses, counting only those whose heights are within a narrow voltage range, the lower limit of which is variable from 1 to 50 V.

Two exhibitors showed closed-circuit television equipment for use in inaccessible positions or where there are risks involved in direct observation. The flying spot microscope was shown in more developed form than last year. An unmodulated raster is optically reduced in size and scans a very small area of specimen. The transmitted light, modulated by the variations in optical density of the specimen, falls on a photo-multiplier the output from which modulates the synchronized raster on a 12in tube. Electrical control of contrast and brightness is simple, the risk of specimen damage is greatly reduced, and the display can be seen by large audiences. The prototype of this instrument, developed for medical research purposes such as the counting of brain cells, was displayed elsewhere.

Engineering in Europe

Abstracts from Foreign Technical Journals

THE author presents an analysis of the influence of the geometrical configuration of an insulator surface on the dry and wet flashover voltages of the insulator in a dirty condition, the insulator types compared being a corrugated insulator and a smooth spreader insulator. At a low voltage applied to an insulator with a more or less conducting surface layer the breakdown mechanism is prevalently a thermal surface flashover. At the operating voltage (in this case, 5·8 kV) thermal flashover along a surface tracking path occurs.

At 15 kV the phenomenon assumes the character of a flashover in air (impact ionization), particularly on a smooth spreader, so that for higher voltages the length of the insulator is no longer negligible. This applies particularly to surface layers containing alkali salts, since the metal vapours of NaCl contaminate the flashover path with electrons and reduce the flashover voltage of smooth spreader insulators. The thickness of the surface layer influences the flashover voltage mainly on the corrugated insulator because the distribution of the current heat is here graded by zones corresponding to the grooves, in other words, localized in certain zones.

The corrugated insulator has a higher flashover voltage with a thinner moisture "skin" than with a thicker one, even if their resistances are equal, owing to the smaller thermal capacity of the former. The superiority of a short corrugated spreader over a smooth spreader about 1·5 times longer was confirmed by tests in the resistance range 10–900 kΩ, corresponding to a surface resistivity of 16–1,400 kΩ. This applies all the more to the extraneous surface layers occurring in practice, the resistivities of which are between 100 and many thousand kΩ.—"The Corrugated Insulator with an Extraneous Layer on the Surface," H. v. Cron, *E.T.Z.* (*A.*), Vol. 75, No. 3, pp. 65–69, 1st February, 1954, in German.

Ultrasonic Tests on Ceramics

Two kinds of defects of ceramics, particularly of insulator materials, usually escape detection by the conventional non-destructive testing methods (mainly h.v. tests), viz., a water-absorbing structure due to insufficient vitrification of the material (not identical with porosity, since a porous insulator may be well vitrified and need not absorb water), and cavities, cracks or similar internal defects of the material. The first of these shortcomings can be easily and unmistakably established by ultrasonic methods, either by what is known as the absorption method or by measuring the speed of the "sound," particularly if a perfectly dense standard specimen is available.

Cavities or inclusions of foreign bodies, or open cracks along the separating surfaces of composite bodies may also be detected by ultrasonic tests and, in many cases, by electrical tests as well, so that one method may be checked by the other. It should be noted that ultrasonic tests are so sensitive that it is not easy to decide whether the irregularity discovered justifies rejection of the piece tested, since the defect might be so small as to be harmless. This will also depend on the ultimate service conditions of the insulator, since many insulators are under relatively low stresses, e.g., not under internal breakdown or puncturing stresses. On the other hand, such insulators are as a rule under higher mechanical stresses and these must also be considered in relation to the nature of the defect recognized.

Despite the superiority of ultrasonic over electrical methods, certain limitations are imposed even on the application of the former, mainly by too complicated geometrical configurations of certain insulator types which cause reflections masking existing deficiencies or else indicating non-existing ones.—"Experience with the Use of Ultrasonic Methods in the Production of Ceramics," H. Barthelt, *E.T.Z.* (*A.*), Vol. 75, No. 3, pp. 69–71, 1st February, 1954, in German.

Ferroelectric Ceramics

Seignette salt and other crystalline ferroelectrics have very remarkable and valuable dielectric properties, but also characteristics making them unsuitable for technical uses, above all chemical and thermal instability and anisotropy of the dielectric characteristics, bad mechanical properties, solubility of the crystals, rapid decrease of the dielectric constant with increasing frequency, and, above all, very low dielectric strength. All the required technical characteristics may be obtained in a comparatively simple way by the production of poly-crystalline ferroelectric ceramics, and the rapid development of these materials opens a completely new field, viz., that of ferroelectric apparatus having certain analogies to electromagnetic apparatus, and combinations of the two types of apparatus. Last, but not least, characteristics having no parallel in the ferromagnetic field, e.g., the piezo-effect, may be utilized.

The author presents a comprehensive discussion of the peculiarities and characteristics of the technically important ferroelectric ceramics according to the present state of the art and typical examples of the possible and actual uses of these novel materials as capacitors with strongly temperature-dependent capacitance, or nearly temperature-independent capacitance, capacitive current generators, high-ϵ varnishes, compounds and plastics, time delay elements for use in pulse and c.r.o. circuits, electronic calculating machines, etc., thermo-compensating capacitors, capacitive thermometers and hygrometers, temperature-controlled reversing circuits for motors, voltage and current stabilizers, high-sensitivity non-linear measuring bridges, wattmeters, including integrating instruments, f.m. and a.m. circuits, directional acoustic emitters, piezo-telephones, acoustic pick-ups, pressure gauges, gradient-meters (electric sondes), capacitive frequency-multipliers, pulse generators and peak transformers, and capacitive power amplifiers. Basic circuits and fundamental relations of many of these apparatus are given and experimental data on types tested are added.—"Ferroelectric Ceramics in Electrical Apparatus," D. M. Kazarnovskii, *Elektrichestvo*, No. 2, pp. 40–51, 1954, in Russian.

D.C. Instrument Transformer

The measurement of large d.c. currents and voltages is still a very difficult problem, particularly where current measurements by means of shunts are concerned, since the circuits are complicated, expensive and must be reliably

Readers who require accurate full translations of any of the articles abstracted in this section can be put into touch with the translators who will supply them at current rates.—Editors, *Electrical Review*.

insulated from the h.v. system. It is thus understandable that attempts were made at using the " d.c. transformer " for the purpose, but so far these attempts have not been successful, among other reasons because of the strong distortion of the voltage waveform.

The authors suggest the use of the principle of the frequency doubler working in almost short-circuit conditions and prove theoretically and by tests on a model that it is possible to ensure that the effective value of the double-frequency secondary current becomes proportional to the measured direct current and also within wide limits independent of the amplitude variations of the auxiliary voltage (and also its frequency) and that it is uninfluenced by the secondary impedance and the resistance in the circuit of the measured current. The results of the measurements are, furthermore, not affected by magnetic fields and ambient temperature variations.

The d.c. instrument transformer is easy to design if an analytical method previously given by the authors is used, and its cores may be of ordinary electrical steel. Results of tests on a model for a current rating of 500 A and power in the secondary circuit of 50–60 W confirm the theoretical predictions. Even in this primitive model the total error under the most unfavourable conditions did not exceed 2 per cent. The construction is simple, cheap and reliable. —" A D.C. Instrument Transformer," I. A. Zaitsev and A. V. Kalyaev, *Elektrichestvo* No. 2, pp. 21–25, 1954, in Russian.

Self-Regulating Alternators

Brush " Amplidex " System of Control

To meet the demand for machines capable of operating continuously with the minimum of maintenance self-regulating alternators with ratings up to 150 kW have been developed by the Brush Electrical Engineering Co., Ltd. The " Amplidex " control system is employed and a virtue of this is that it can be applied to an alternator of standard construction.

To control the alternator two exciters are connected in cascade. The field system of the main exciter is laminated and compensated. The stator is wound with concentrated excitation windings and a fully distributed compensating winding. Compensation results in high amplification and quick response. It also ensures good commutation during the field forcing required to restore the alternator voltage quickly on sudden changes of load. A damping circuit is included so that the maximum recovery rate can be maintained with stability.

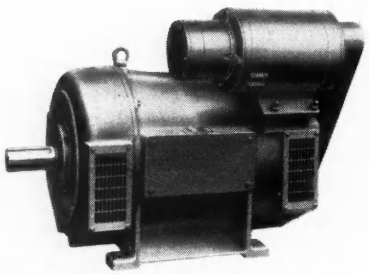
The operation of the " Amplidex " control system can be understood by referring to the diagram, where the alternator voltage is fed through an isolating transformer A to two bridge rectifiers B and B1, one shunted by a saturated reactor C and the other with a series capacitor D. The outputs are applied to two resistances in series the difference in voltage across which supplies the error signal to the sub-exciter. A small rheostat is provided for setting the alternator voltage.

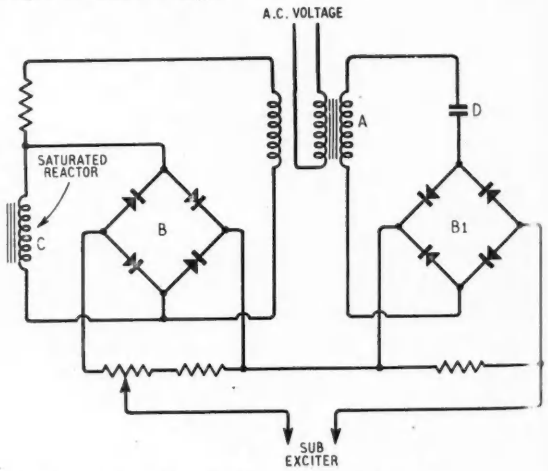
The saturated reactor holds the voltage constant across one rectifier but the voltage of the other varies with the alternator voltage. When the two voltages are equal no current will be supplied to the exciter field. If the alternator voltage varies the exciter field current will vary in magnitude depending upon the strength and direction of the error signal, thereby rapidly correcting the terminal voltage.

The reference voltage provided by the saturated reactor is sensitive to frequency but so also is the current in the capacitor fed by the rectifier. Thus no variation due to frequency changes results.

Alternators with this control system give a voltage regulation of $\pm 2\frac{1}{2}$ per cent from cold to hot, at variable power factors—no load to full load—allowing for the usual 4 per cent engine speed variation. When full load at 0·8 power factor is thrown off, the voltage rise is arrested in less than 0·2 sec and the voltage overshoot is within 20 per cent of normal voltage. Throwing off at full load unity power factor is less onerous and very little disturbance of the voltage occurs. Conditions for throwing on load are similar. Within the limit of full rated kVA, voltage recovery is obtained in one second or less for any condition of load change.

The system will operate over a wide voltage range such as 380–440 V and a frequency range of 50–60 c/s. If necessary a series-parallel stator connection may be provided to give dual voltage when required. In this case the connections to the control circuit remain unchanged so that both voltage ranges are covered by the same rheostat. The scheme permits delivery of full rated output at either voltage.

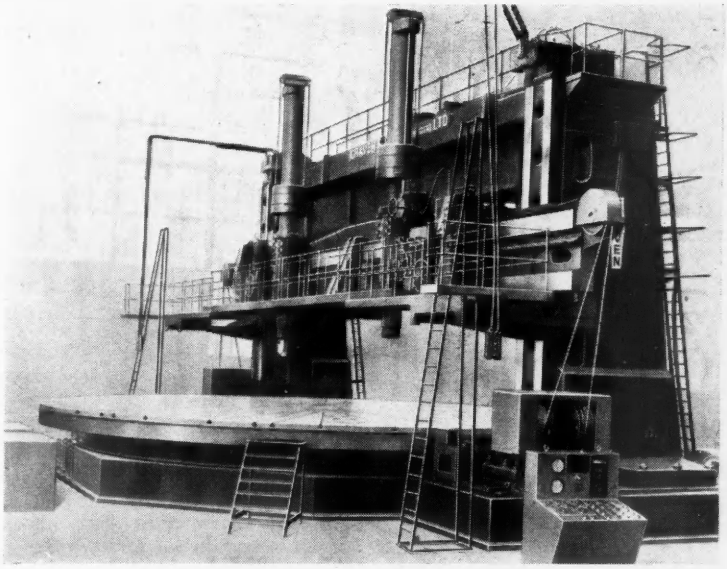




Brush self-regulating alternator with " Amplidex " system of control and the simplified circuit diagram of the control system

Machine Tool Control

Scheme for a Very Large Boring Mill



With a 41ft diameter table this boring and turning mill will take work up to 42ft 6in diameter and 13ft 4in high

TO machine the largest and heaviest engineering equipment, such as electrical generators and hydro-electric plant, calls for machine tools which are themselves of exceptional size. Such a machine is the 42ft vertical boring and turning mill recently completed by Craven Brothers (Manchester), Ltd., to the order of the English Electric Co., Ltd., for its Canadian associates John Inglis Co., Ltd.

The machine weighs about 650 tons and can handle a workpiece weighing up to 140 tons and 42ft 6in in diameter. The rotating table is 41ft in diameter and weighs about 170 tons; the speed of continuous rotation is from 0·15 to 3·5 r.p.m., but for the purpose of machining intermittent surfaces, the table is also adapted for automatic partial rotation and reversal in the manner of a planing machine.

The cross-slide, which weighs 72 tons, is equipped with two saddles, each having a hexagon ram fitted with a three-position tool box; the rams can be set at any angle up to 30 deg from vertical. An individual electric motor actuates the vertical motion of the cross-slide. Other individual motors drive the cross traverse of the saddles and the vertical travel of the rams, and the swivel slides also have individual drive.

In all, twenty-eight separate motors and generators are employed to effect the movement and control of the machine. To secure the maximum degree of safety and convenience in operation a comprehensive system of electrical interlocking and special control circuits were designed. Craven Brothers, who were responsible for the general design of the whole electrical scheme, entrusted this work to Brookhirst Switchgear, Ltd. The motors and generators were supplied by the English Electric Co.

Main Drive

The main drive to the rotating table is by two electrically coupled 150 h.p. variable-speed motors with a 3 to 1 speed range, operated from a single 410 h.p. Ward-Leonard type motor-generator set. The primary supply for the whole machine is 550 V, three-phase, 60 c/s; from this the motor-generator set and all the smaller auxiliary motors operate. Push-button switches and control circuits for the auxiliary motors work on 110 V, 60 c/s, while those for the main driving motors, feed motors and elevating motor operate on 220 V d.c. from the motor-generator set. The latter comprises five units: the main driving motor, a variable-voltage main generator, an auxiliary generator supplying 220 V d.c., a control exciter for the main generator field, and a constant-voltage exciter for the main motor fields and control circuits.

The control gear for the main drive consists of an Ellison oil-immersed circuit breaker interlocked with a Brookhirst rotor starter, comprising a solenoid-operated starting controller, d.c. operated from a rectifier, three starting and one final rotor contactors. The output to the two main motors from the motor-generator is governed by a constant-current control system provided by the English Electric Co. The generator shunt fields are fed from the control exciter of the motor-generator set; this is under the control of a magnetic amplifier which limits the rate of acceleration and the current taken by the main motors during starting and reversal. A motor-operated regulator on the Brookhirst panel controls the field of the control exciter; when the regulator has functioned over the range covered by voltage control, a further increase in speed is obtained by weakening the fields of the table driving motors. Accelerating and retarding contactors are fitted so that the regulator may be pre-set to any required speed. The acceleration of the table motors at starting is automatically controlled, partly by the constant-current control system and partly by field contactors; the latter also function for inching and for retarding the table previous to reversal when oscillating.

Dynamic braking is brought into operation when the "Stop" button is pressed, by the opening of the main contactor and the closing of a braking contactor. The oscillating or planer-type motion is controlled by adjustable trip dogs on the edge of the table, which act upon switches mounted on the bed adjacent to the right-hand upright. A retarding switch comes into operation just before the reversing switch is operated; this brings the motor field to full value, giving a braking effect immediately before reversal.

Cross-Slide Unit

A 40 h.p. d.c. elevating motor raises or lowers the whole cross-slide unit through worm-reduction gearing and four vertical screws and long nuts built into slide. Locking mechanisms, operated by two 3 h.p. motors, lock the cross-slides to the uprights. The elevating motor is controlled by a Brookhirst automatic solenoid-type starter, double-pole reversing contactors, overloads and dynamic braking feature, interlocked with the locking motor control. Each

saddle has a 5 h.p. variable-speed motor which provides horizontal traverse of the saddle along the cross slide and vertical traverse of the ram.

Controls for these motors are incorporated in pedestals on the saddles, which also duplicate the main motor control buttons. Two types of feed motion are available: first, continuous feed to both saddles, forward or reverse, used when the table is rotating normally; and secondly, index feeding to the right-hand saddle only by the "Craven" planer feed system, the amount of feed being selected by two graduated dials on the saddle, and feed reversal effected by hand operated switch. Quick power traverse of the saddle and the ram is also available.

The main control desk is divided into right and left hand sections. The right hand side is for "setting-up" and the left for "operating." A Cambridge oil temperature indicator (with alarm) gives the temperatures at ten points at 10 sec intervals. Gear changing in the main gearbox and the main friction clutch operation are also effected from the main desk. Thirteen coloured safety lights indicate at a glance the position of the more important controls.

Entry to Consumers' Premises

Effect of the New Act

By C. F. MAYSON, A.M.I.E.E.

IN 1951 the Court of Appeal affirmed the decision of Mr. Justice Hilbery in *Grove* v. *Eastern Gas Board** that the Gas Act, 1948, empowered the Board to make a forcible entry on to premises for the purpose of collecting money from a prepayment meter. What had occurred was that collectors had made repeated calls at Mr. Grove's residence and had been unable to obtain admission; prepaid postcards which had been left at the house were not returned.

Finally, three months after the first call had been made, an inspector (who was accompanied by a carpenter) was authorized to enter the house by force and to carry out his routine duties of emptying the coin-box and inspecting the meter. Entry was gained by the removal of a pane of glass by the carpenter, which he replaced upon leaving. Mr. Grove sued the Board on the ground that the entry was unlawful and a trespass, but it was held that the Gas Act of 1948, and the earlier legislation, clearly authorized what would otherwise be an unlawful entry.

It will be remembered that, at the time, this decision was received with feelings of alarm by law-abiding citizens, many of whom envisaged it as yet another curtailment of private liberties. Consumers of gas were not the only ones who had cause to worry, for there was good reason to hold (although it has not been tested) that the Electricity Acts conferred similar powers upon Electricity Boards.

The position as to rights of entry by Electricity and Gas Boards has now been regularized by the passing of the Rights of Entry (Gas and Electricity Boards) Act, 1954, which came into force on 18th April, and applies to England, Wales and Scotland (but not to Northern Ireland). By its provisions (which nullify the decision in Grove's case) there is no right of entry into any premises, except in cases of emergency, unless either the occupier gives his consent or a warrant has been granted by a justice of the peace (s. 1 (1)). The Act applies to all statutory rights of entry, whether under the Electricity or other Acts (s. 1 (2)).

In order that a warrant may be issued, a sworn "information" must be presented to a justice of the peace, showing that admission is reasonably required for a specified purpose and that that purpose is one for which the Board is entitled to a right of entry. Provided the requirements of the relevant enactment have been complied with (such as the Electricity Act, 1947, s. 63, with regard to notice), the justice *may* (not *must*) issue a warrant of authority to enter the premises, if necessary by force (s. 2 (1)).

Where in any case a right of entry is given by statute, but notice is not required, a justice must not grant a warrant unless he is satisfied that twenty-four hours' notice has, in fact, been given to the occupier, or that admission has been refused "in a case of emergency," or that the premises are unoccupied, or that to apply for admission "would defeat the object of entry" (s. 2 (2)). "A case of emergency" is one in which there is "reasonable cause to believe that circumstances exist which are likely to endanger life or property, and that immediate entry to the premises is necessary to verify the existence of those circumstances or to ascertain their cause or to effect a remedy" (s. 3 (3)).

Entry under warrant is deemed to be entry under the authorizing statute, and any obligation to make damage good or to pay compensation remains (s. 2 (6)). If there are no such provisions, unoccupied premises must be left as effectively secured against trespassers as they were found. These are simple provisions, but they should do much to allay the fears of consumers, whose homes thereby remain their castles.

* *Law Reports* (1951), 2 *King's Bench* 586; (1952), 1 *King's Bench* 77.

Public Lighting Conference

THIS year's conference of the Association of Public Lighting Engineers is to be held at Eastbourne from Tuesday, 14th to Friday, 17th September. An interesting programme has been arranged, whereby papers dealing with various aspects of matters relating to street lighting will be presented at the technical sessions which are to be held in the Winter Gardens, Devonshire Park. Apart from the presidential address by Mr. L. A. Doxey, street lighting engineer, Leeds, five papers are to be presented.

There will also be an exhibition of street lighting apparatus and equipment in the Pavilion, Devonshire Park, which will be open throughout the period of the conference and, in addition, on the ground adjoining the conference hall there will be displayed various types of steel and concrete lamp columns, road safety signs, tower wagons, extending ladders, etc. Local authorities throughout the British Isles are already appointing delegates, and early indications point to a large attendance.

Cold Cathode Street Lighting

New System Inaugurated at Aberdeen

THE first section of a street lighting system which is the only one of its kind in the world was officially switched on at Aberdeen on 9th April by the Lord Provost, the Rev. Professor J. M. Graham.

Aberdeen's most striking feature is the layout of its main streets and the design of its buildings, and when the re-lighting was planned the superintendent of lighting (Mr. R. Parker) and the director of town planning (Mr. J. E. Barlow) worked closely together on the local problems. Union Street, bordered by dignified granite buildings, is the main trunk road on which all radial roads converge. In 1950 a scheme was considered for this area using G.E.C. "Four Eighty" vertical fluorescent lanterns and a number were installed experimentally. The new G.E.C. cold cathode lantern was introduced soon afterwards and since it was felt preferable to light Union Street without using columns this lantern, which is adaptable for wall mounting, was incorporated in the scheme and the "Four Eighty" lanterns were used elsewhere. By employing "Osram" cold cathode fluorescent tubes, which have a life of 15,000 hours, maintenance work has been greatly reduced. It is unlikely that the lanterns will have to be opened for about four years; when attention is needed each lantern can be removed from the wall and quickly replaced.

Each lantern has five 67½ W tubes with a total light output about equal to that of a normal main road lantern with a 400 W mercury lamp. The tubes are inside an opal "Perspex" cylinder with decorative aluminium fittings, which house the transformers and control gear. Erection of the lanterns is being carried out by the Council's Street Lighting Department. Special crates with rubber mountings were needed for safe transport of the lanterns, which are over 6ft long, from the G.E.C. works at Wembley.

Mounting plates for the lantern brackets are each fixed to the buildings by three "Rollofix" wall anchors. Nearly 1,000 holes for these had to be tapped in granite with pneumatic hammers using tungsten tipped tools. The electricity supply is taken from rising mains at the foot of the buildings. Firemen's switches to isolate sections are fixed at intervals. Wiring along the faces of the buildings is in aluminium sheathed rubber covered cable, the aluminium sheathing toning well with the granite. Time switch control is being used until a central control system is approved.

Spacing and mounting heights have been varied in some cases to suit the buildings and to give the best overall impression of the lighting system. The wall brackets have been specially designed to allow the lanterns to be removed without disturbing the wall fittings. They also allow adjustment to be made in the projection from the buildings' faces. Where the building heights and the building line vary markedly, special brackets are used to keep the lantern arrangement symmetrical. Some special brackets are on the corners of buildings; others, like flagpole mountings, give extra height where needed.

Reflected light from the buildings is a valuable factor where a wide street is lighted by wall mounted lanterns and the Council possesses statutory powers to require the property owners in Union Street to clean the building exteriors when necessary.

Erecting one of the new lanterns

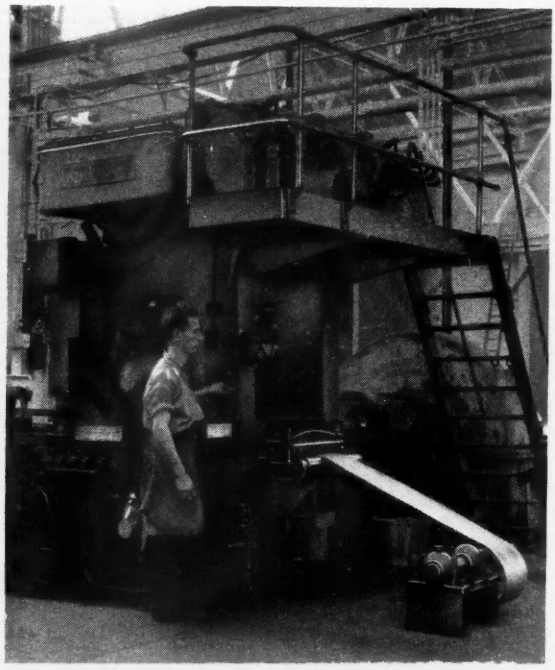
At Union Bridge, wall mounting was not possible and columns are used. Because of the structural characteristics of the bridge, special lightweight aluminium columns had to be designed to carry the lanterns. These have been made to withstand the stresses caused by gales of up to 100 m.p.h. Some post-mounted lanterns are also used to ensure adequate lighting in the broad Castle Street.

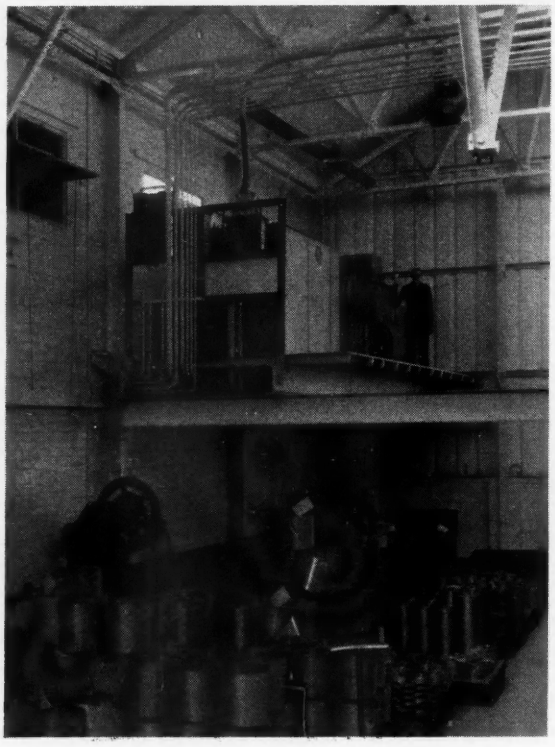
When the system is complete 170 of the latest type cold cathode fluorescent lanterns will be in use.

Mounting heights and spacings of G.E.C. cold cathode fluorescent lanterns are arranged to suit the architectural features: Union Street (left) and the Town House (right)

Variable Speed Drives

Applications in the Metal Working Industry





Non-ferrous strip mill at the works of D. F. Tayler & Co., Ltd., with the "Varispeed" equipment in the gallery

WHILE the advantages of variable speed drive in assisting production, reducing costs, etc., are apparent in a large number of industries, in particular the textile, rubber and gas, there is no sphere in which its application is more widespread than in the various branches of metal working. Recently we were given the opportunity of seeing in the Birmingham district a few of the uses of the "Varispeed" drive in this field as well as, for the purpose of further indication of versatility, in a gas booster station.

The "Varispeed" drive was patented and is produced by the Electric Construction Co., Ltd., and it consists of a mercury arc rectifier and a standard d.c. motor. The rectifier is arranged to give two separate d.c. supplies, one for the field and the other for the motor armature. The supply to the field is normally maintained at a constant value to give full excitation of the motor: the supply to the armature can be varied to give the motor infinitely variable speed from zero to maximum. Throughout the speed range the torque is constant, acceleration is completely smooth, and both efficiency and power factor are high.

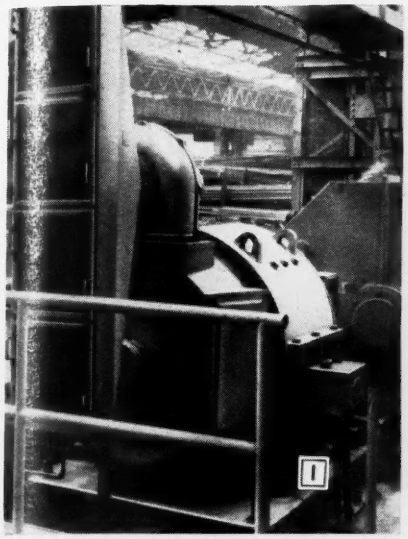
Originally a wartime development, the "Varispeed" drive was first produced in 1941 for use on a duplex sawing machine engaged in the manufacture of aircraft components. The motor was employed for operating the table of the machine and provided from ½ h.p. at 300 r.p.m. up to 3 h.p. at 1,800 r.p.m. in the forward direction. In the reverse direction it was capable of 3 h.p. over a speed range of from 1,800 to 3,000 r.p.m. The rectifier and control equipment were suitable for fitting into the machine tool and so arranged that the liquid coolant and duralumin swarf were prevented from entering the cubicle.

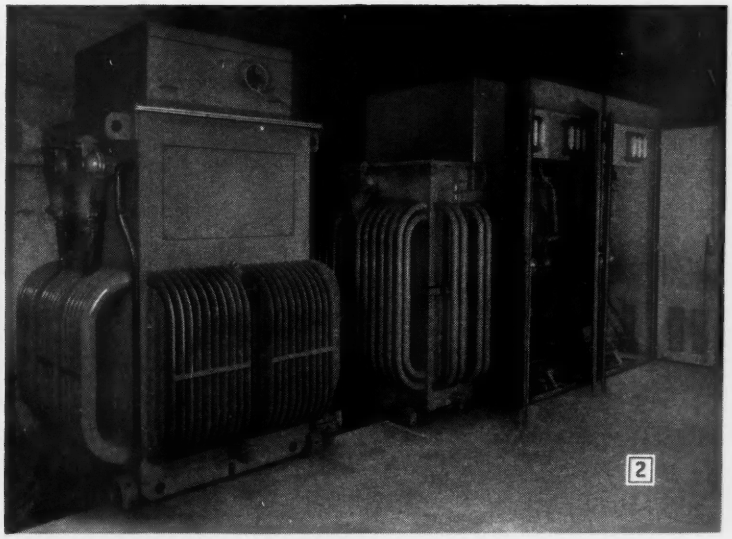
Several of these equipments were produced and later in 1941 the "Varispeed" principle was applied to aircraft spar millers. On the first batch of six of these equipments the feed motor was 5 h.p. and the cutter motor 25 h.p. By the end of 1942 advances in the design of spar millers necessitated the horse power of the cutting motor being increased to 75. The complete equipment, comprising rectifier, control gear and motor, was mounted on the head of the machine and travelled with the cutter. It is quite usual for the glass bulb type of rectifier to be used for arduous duties of this type.

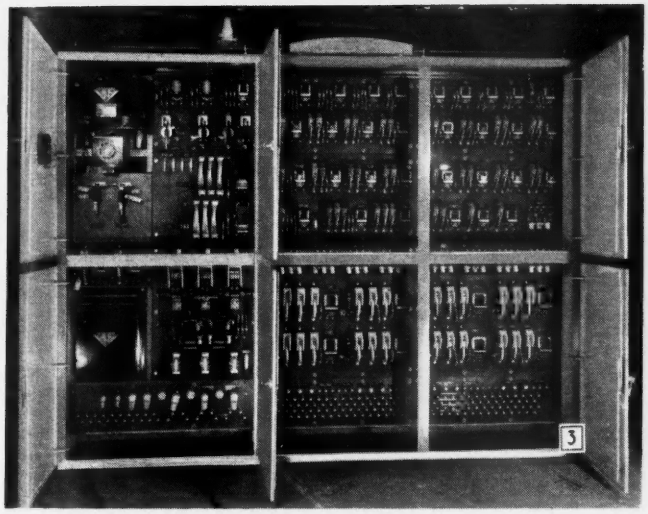
The development of this special milling machine, and the application of the "Varispeed" drive, enabled the machining of two centre section Lancaster spars to be completed in 20 minutes. In the heaviest cut metal was removed at the rate of 250 cu in/min. Previously this operation took several hours.

This type of drive was used on several kinds of machine tools, grinders, etc., requiring up to 30 h.p. until in the middle of 1942 the principle was applied to tube draw-benches. The first of these controlled a 125 h.p. motor used for the making of tubes. While on smaller equipments grid control had been used, on this larger type of equipment induction regulator control was used to overcome the inherent disadvantages of voltage control by wave-chopping. This proved highly successful and since then draw-bench and other equipments have been made. Now 550 h.p. equipments are quite common.

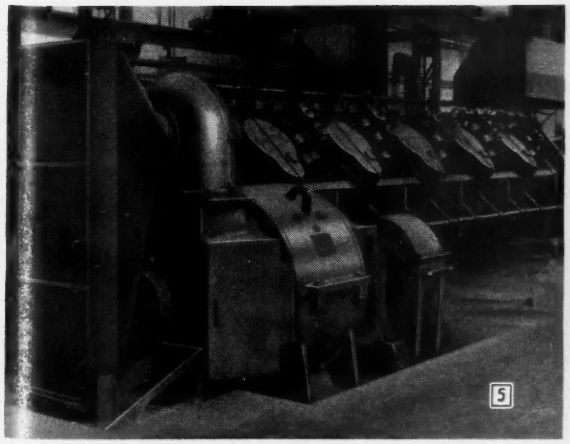
The first installation we were shown was at the works of D. F. Tayler & Co., Ltd., where a "Varispeed" has been







(1) 456 h.p. motor driving a triple-draw tube bench designed and manufactured within the Tube Investments Organization and installed at Tubes, Ltd., Rocky Lane works. (2) The rectifier and the induction regulator equipment at the Rocky Lane works. (3) Contactor switchboard at the same works. (4) Control desk at the works



(5) 200 h.p. motor driving wire drawing machine at the United Wire Works (Birmingham) factory. (6) Rectifier equipment induction regulator and control panel at this Birmingham factory

in operation for the past three years driving a Farmer Norton rolling mill for non-ferrous strip. The mill operates at a speed of from 150 ft to 350 ft/min to reduce in a number of passes 5–14in wide strip from 0·056in thick to, if desired, as little as 0·018in. An unconventional but increasingly popular layout has been adopted here with the rectifier and induction regulator mounted on a gallery overlooking the plant. The 180 h.p. non-reversing motor is arranged to drive the mill motor at between 0 and 1,200 r.p.m., allowing slow entry of the strip between the rollers and rapid acceleration to the pre-set speed. The motor is pressure-ventilated.

At another works we saw a number of other different types of non-ferrous rolling plant in which similar systems of operation have been adopted, including a twin 18in mill with a 400 h.p. motor reducing the thickness of 18in strip from 0·3in to 0·065in, at a speed of 70 ft/min. On a hot reversing mill the screwdown gear was driven by a 10 h.p. grid controlled "Varispeed" unit operating 200 times an hour for 16 hours a day.

Three separate "Varispeed" units are employed for tube making at the Rocky Lane works of Tubes, Ltd. The first to be installed was, in fact, the unit referred to above for controlling a 125 h.p. motor. It is employed on a 60 ton pull bench dealing with tubes up to 8in dia at a maximum speed of 50 ft/min. The second drive, which has been in operation for three years, is to be found on a tube-bench designed and manufactured within the Tube Investments Organization. With an 80 ton pull this 4oft bench also handles tubes up to 8in, at a speed of 180 ft/min, and is operated by a 333 h.p. motor.

It is only a few months since the third unit was put into operation. This is a Head Wrightson 40ft triple-draw bench handling 2½in dia tube (3½in in a double draw and 4½in in a single draw) at a maximum speed of 240 ft/min. A 456 h.p. motor is provided with three draw-out type mercury arc rectifiers and automatic control gear.

For drawing wire from $\frac{13}{16}$ sq in to $\frac{5}{16}$in out of 1½ sq in bar the United Wire Works (Birmingham), Ltd., employs a 200 h.p. 0–1,600 r.p.m. "Varispeed" equipment to drive a 12 head machine. Adjustment of the pre-set maximum speed is necessary when dealing with different alloys. Control is again by means of an induction regulator.

At the gas booster station to which we have referred the speed of a 460 h.p. motor is regulated to between 750 and 1,500 r.p.m. for driving a Bryan Donkin booster required to maintain a constant gas pressure in the Washwood Heath district of Birmingham. Supply for the booster motor is taken from two six-phase rectifiers running in parallel and motor speed regulation is by shunt control.

We are grateful to the various manufacturers for the facilities given to us to inspect the installations, and to the Electric Construction Co., for provision of the various photographs.

Work for the Disabled

Extension of the Electrical Manufacturing Activities of Remploy, Ltd.

In accordance with its policy of providing as wide a range of employment as possible for disabled men and women Remploy, Ltd., is considerably expanding its activities in the electrical manufacturing sphere and several of its ninety factories, which now provide work for about 6,500 persons, are already, or shortly will be, producing a number of electrical items. Despite the severe physical handicaps of the employees, an exceptionally high standard of workmanship is demanded and their products are designed to sell on quality rather than for any sentimental reasons.

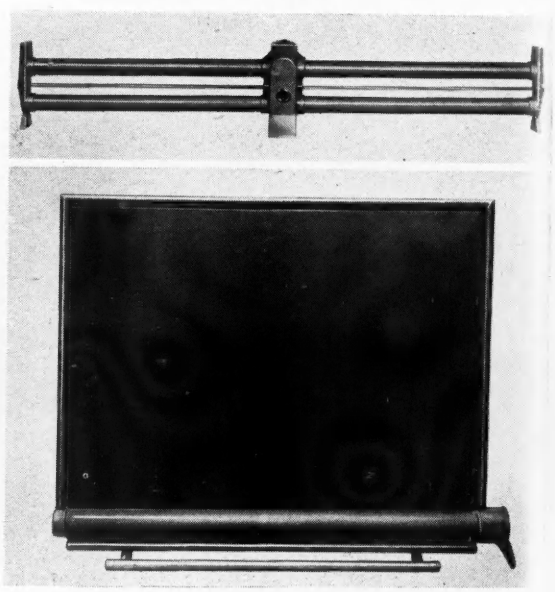
One of the first electrical appliances to be developed is an automatic water filled greenhouse heater. Loaded at 750 W and measuring 6ft 8in long and 1ft 2in deep, it is of rustproof construction throughout and the immersion element is made from tubular copper, solid drawn and nickel plated, with an automatic safety device incorporated to prevent damage in the event of the heater running dry. A Kieft thermostat is supplied for controlling the temperature of the air between 35 deg F and 75 deg F.

A 500 W oil filled radiator will also be available within the next few weeks in both free standing and wall models, and a 1 kW type will follow later. The apparatus measures 27½in high by 25"in wide by 2½in deep and is attractively finished in bronze. It incorporates an immersion type element and is supplied with 2 yd of flexible cable. A soldering iron is another new item and a contract has also been made with an American company for the production of a complete range of tubular heaters for use in oil, air and chemical solutions as well as water.

Other articles of interest to the electrical industry already in production include tool chests, small hand tools, jigs and fixtures, press tools and pump equipment. It is also the company's intention to manufacture certain electrical instruments and it is at the moment investigating this market.

Besides making wooden packing cases, cardboard boxes and cartons for sale to various industries, the P.I.P. (Preservation, Identification, Packaging) Group offers a comprehensive packaging and pre-packaging service. In addition the company is prepared to quote electrical firms for subcontracting work.

Remploy water filled greenhouse heater and (bottom) oil-filled radiator (500 W)



Generation in March

FOLLOWING December's exceptional increase of 512 MW the installed capacity of the power stations of the B.E.A. and North of Scotland Hydro-Electric Board remained at 19,169 MW until last month, when there was a net addition of 63 MW. New plant installed during March at B.E.A. stations included a 60 MW G.E.C. generating set at Uskmouth, a 320,000 lb/hr Clarke Chapman boiler at Brunswick Wharf, a 250,000 lb/hr Foster Wheeler boiler at Deptford East, a 180,000 lb/hr Mitchell boiler at Doncaster, and a 30 MW Parsons set together with a 300,000 lb/hr International Combustion boiler at Connah's Quay.

The total quantity of electricity generated in March was 6,650 million kWh, the rate of increase compared with last year (11 per cent) being again above the average though lower than in February.

ELECTRICITY GENERATED AND PLANT INSTALLED*

	Fuel consumed Thousand tons			kWh generated Millions			kWh sent out Millions	Installed capacity (m.c.r.) MW
	Coal	Coke and Breeze	Oil	Steam	Water power	Total†		
British Electricity Authority ...	3,512	110	12·2	6,476	40	6,524	6,136	18,665
N. of Scotland H.E.B.	23	1	1·2	32	89	126	125	567
Total for March, 1954	3,535	111	13·4	6,508	129	6,650	6,261	19,232
Corres. total for March, 1953 ...	3,262	88	6·2	5,891	86	5,992	5,642	17,788
Increase or decrease, per cent ...	+8·4	+26·1	+116·1	+10·5	+50·0	+11·0	+11·0	+8·1
Total to date (3 months), 1954 ...	10,956	321	47·9	19,918	422	20,382	19,203	
Total for corres. 3 months of 1953	10,127	271	25·6	18,049	307	18,403	17,346	
Increase or decrease, per cent ...	+8·2	+18·5	+87·1	+10·4	+37·5	+10·8	+10·7	

* Comprising all stations controlled by the British Electricity Authority and the North of Scotland H.E.B.

† Includes 8 million kWh generated by oil engines and 5 million kWh by waste heat plants in March, 1954.

Farm Supplies

At a meeting of the Blackburn District Committee of the North Western Electricity Consultative Council, Mr. R. H. Harral, Blackburn Sub-Area manager, said that instead of the planned total of 245 farms in 1953–54, supplies had in fact been given to 314 farms in the area. The average power consumption by farms in the Blackburn Sub-Area, however, was only about 1,000 kWh a farm annually, a low figure which was exceeded by many ordinary domestic consumers. It was clear, said Mr. Harral, that most farmers had not realized what benefits electricity could bring them. Councillor R. Williamson (Clitheroe) said more effective publicity would help in overcoming this problem and he felt that more might be done through the National Farmers' Union.

Accelerating Rural Electrification

New plans to take electricity to 5,000 more farms and 24,000 other rural premises in the next five years were outlined by Mr. S. F. Steward, C.B.E., chairman of the South Western Electricity Board, at the last meeting of the South Western Electricity Consultative Council. He also announced a new system of connection charges for mains supplies of electricity to all new consumers in the countryside. He said that in the South West there were now twice as many farms with electricity as before nationalization. The most difficult part of the Board's task lay ahead, but it was able to tackle the next stage in the knowledge that the electricity supply industry was now treating the problem of uneconomic rural development as a national matter.

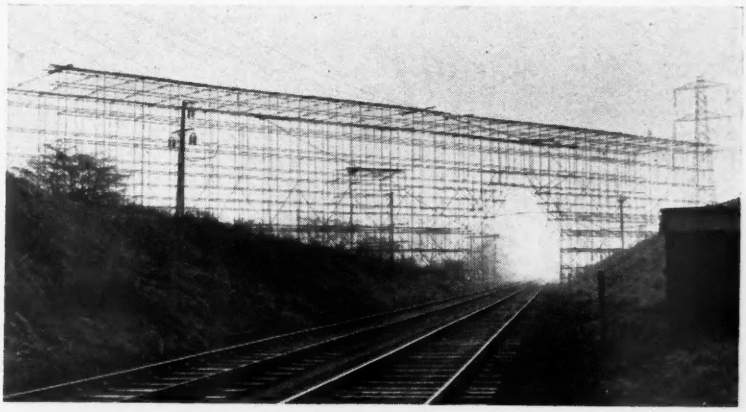
Mr. Steward recalled that in 1950 the Board had introduced a line rental scheme to bring about the speediest possible connection of farms and other rural premises within economic reach of the Board's distribution system. The new system of connection charges was designed to cater for the territories still awaiting development. The principle of sharing costs, which was a feature of line rentals, was being extended to cover a wider field than the individual group schemes. Future rural consumers would pay standard supplementary charges, scaled to suit the various types of premises, instead of bearing the costs of their local group schemes through line rentals. These supplementary charges, called "rural development contributions," would work out at only 1s 6d a week for small cottages, 2s 4d a week for medium sized houses and 10s 5d per week for the average sized farm (including its farmhouse) and would cease after seven years. Where a consumer preferred it, the Board would accept the rural development contribution as a lump sum payment, and this would enable farmers to take full advantage of any grants for which they were eligible under the Hill Farming and Livestock Rearing Acts. Existing line rental consumers would be given the option of changing over to the new terms. To encourage consumers to make the best use of their supply, refunds on their rural development contributions would be given to those who used electricity extensively in their homes, on the farm or in business premises.

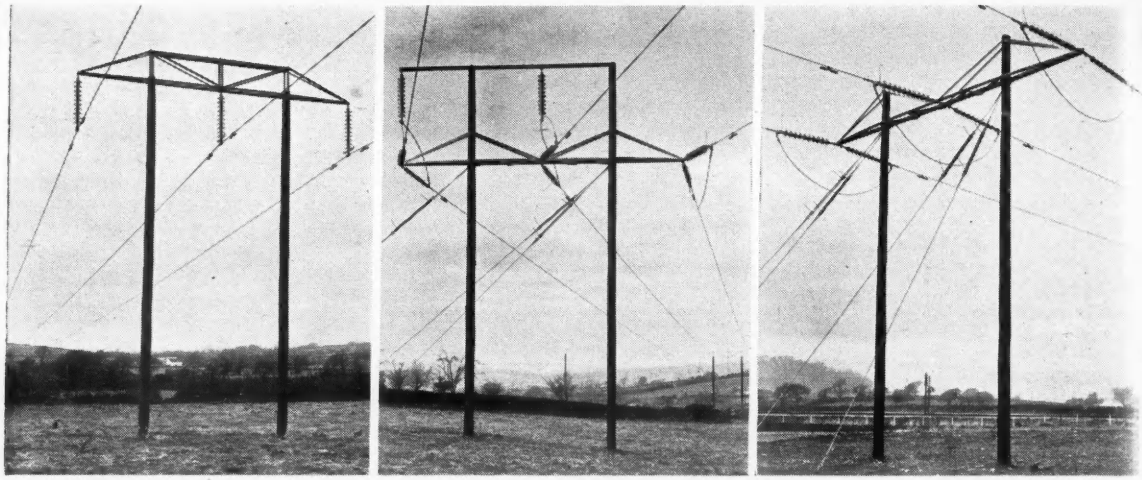
Erecting Supergrid Lines

Large tubular steel scaffolds were used by engineers of British Insulated Callender's Construction Co., Ltd., engaged on the erection of the Stella-Thirsk section of the 275 kV supergrid. The scaffolds, 240ft long and 50ft high, were built around two sections of a 66 kV overhead line to afford protection while the crossing conductors of the 275 kV line were pulled over and tensioned.

Usually when one high-power line goes over another the overhead line to be crossed is made "dead" while the other conductors are erected and tensioned. In this instance, however, no fewer than thirteen conductors had to be drawn across and as it was estimated that this would take at least four days the necessary shut-down

The 240ft scaffold spanning a railway cutting. A 66 kV line pole can be seen on the left protected by the scaffold





Two-pole straight line support (left), dual-pole line angle member (centre) and two-pole railway crossing section structure (right)

could not be arranged. Recourse had therefore to be made to protective scaffolds and these were erected by Scaffolding (Great Britain), Ltd., for the B.I.C. Construction Co. At one of the crossings it was found that at the point of intersection the 66 kV line passed over a two-track railway cutting and a large arch spanning the cutting was included in the scaffold.

132 kV Wood-Pole Line

An interesting addition to the British Electricity Authority's main 132 kV transmission grid system is nearing completion in South Wales, between Carmarthen and Haverfordwest, where a single circuit three-phase 132 kV overhead line is being erected with wood poles as the supporting members. Although the use of wood pole supports for very high voltage transmission is common practice overseas this construction for an entire line at such a voltage has not previously been adopted in this country.

On this 27 mile route there are 276 pole sites between which the spans are normally 600ft, and the poles used are of red fir, varying between 40ft long by 10½in diameter, and 53ft long by 15in diameter. The cross-arms, which are assembled on site, are of lattice steel construction with pin jointed fixing, and are bolted to the pole tops before erection. The two leg members of the "H" frame are spaced 16ft apart to give a phase spacing of 16ft. Although there are no brace blocks or trussing tackle, kicking blocks to provide an additional resistance to overturning are fitted to intermediate poles and are attached to each leg at a distance of 18in below ground level.

The three line conductors are of the normal grid type, of 0·175 sq in steel-cored aluminium made up of an inner core of seven galvanized steel wires overlaid by 30 aluminium wires, each of 0·11in diameter. The conductors are operated at a slightly higher tension than is generally used on grid work, the tension at 40 deg F in still air being 4,370 lb, as against the normal grid tension for this size of conductor of 3,253 lb. Stockbridge vibration dampers are fitted adjacent to each insulator to deaden the line vibrations.

An interesting requirement of the line specification is that a means of earthing the line during maintenance periods should be readily available, and so a 0·1 sq in copper strand is turned six times round the pole butt to provide an earth and it terminates in a lug fitting arranged for easy attachment to the steel crossarm. This readily accessible earth is to be preferred to the spike earths which would normally be used by a line maintenance gang. To retain the insulation value inherent in the wood pole construction, laminated wood insulators are fitted in all line stays. The line was erected by British Insulated Callender's Construction Co., Ltd.

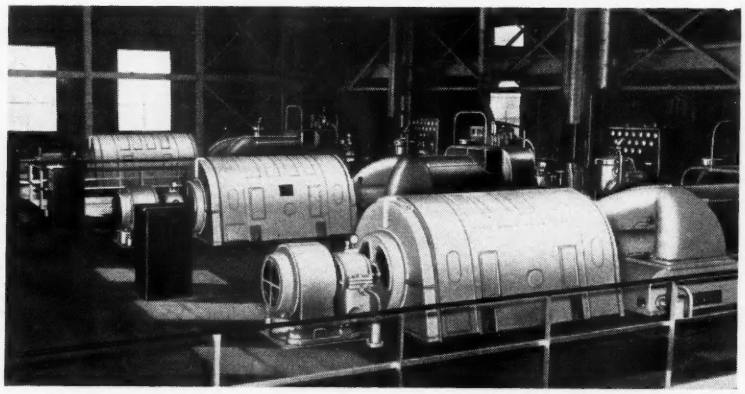
Rewiring Council Houses

Blyth Council is considering the rewiring of nearly 1,000 old council houses on the South Farm estate. The work is estimated to cost over £20,000, but the Council is being recommended not to proceed with the work until houses supplied only with gas are provided with electricity.

Queensland Power Station

The Central power station at Townsville, which was opened in July last year, is making an important contribution to the further development of North Queensland. It contains three 7,500 kW, 3,000 r.p.m., 11·5 kV Metropolitan-Vickers turbo-generator sets, the turbines operating with initial steam conditions of 400 lb/sq in and 750 deg F and exhausting at 28in Hg to M.V. condensers of 9,500 sq ft cooling surface. Two-stage feed heating raises the temperature of the feed water to 200 deg F at the maximum continuous rating, and an evaporator is provided for each unit. The station also contains a house set, consisting of a 750 kW, 7,500 r.p.m. back pressure turbine exhausting at atmospheric pressure, geared to a 1,500 r.p.m. 440 V a.c. generator. Commissioning of this station has made it possible to close down two smaller and less efficient plants.

Three 7,500 kW 3,000 r.p.m. Metropolitan-Vickers turbo-generator sets in the new Central power station at Townsville, Queensland



Alternative Television Programmes

Problems of Receiver Design

At a recent meeting of the Radio Section of the Institution of Electrical Engineers Messrs. K. I. Jones and F. R. W. Strafford opened a discussion on "Technical Problems Involved in Receiving Alternative Television Programmes."

Dealing with receiver design, Mr. Jones said the plan for the extension of the British television service to provide two or more programmes by erecting new stations which would operate in Band III had created three kinds of problem for the television receiver designer. The first was that important details concerning the new transmitters were still unpublished, such as siting and power, and it was well to clarify the plans published so far, together with a brief summary of the characteristics of a Band III transmission and the service area which might be expected. A case could be made for equal service areas, necessitating rather higher effective radiated powers on Band III than on Band II, and for common siting of the aerials serving each area.

Method of Tuning

The second problem was to provide means for tuning the receiver quickly and accurately to a number of different frequency channels. That need had not so far arisen in this country, and sets permanently tuned to one station (and programme) had been the rule. The mechanical problems of tuning were similar to those which had been successfully solved in the United States. A preference for channel selection (analogous to radio receiver push-buttons) rather than for continuous tuning was expected. An increased use of automatic-gain-control circuits was also probable to facilitate rapid programme selection.

The third problem was the design of circuits which would operate satisfactorily at the higher frequencies of Band III and be free from spurious responses and unwanted radiation. The choice of intermediate frequency was so far narrowed by two-band operation that standardization might be no longer a theoretical aim but an inevitable prerequisite of a workable service. The careful control of radiation from the receiver local oscillators on both fundamental and harmonic frequencies became more essential as the frequencies from 40 to 200 Mc/s became increasingly used for television, broadcasting and communication services, and compliance with industrial standards was vital; even so, interference conditions might arise in certain areas unless frequency planning played a part. The application of the new tuning devices to television receivers already owned by the public would become a major operation as the new transmitters were built, and this would raise many problems of interference and breakthrough which would vary according to the area and the type of set involved.

Receiving Aerials

On the question of aerial design, Mr. Strafford said in the absence of data concerning the siting, mode of polarization and effective radiated power of an alternative television transmitter, the receiving-aerial problem was complicated. Neglecting the question of power, there were at least four possibilities for siting and polarization. These were the same siting as the B.B.C. and the same polarization; same siting as the B.B.C. and opposite polarization; separate siting and the same polarization as the B.B.C.; and separate siting and opposite polarization to the B.B.C. With regard to the first two the problem was vastly simplified in that the signal strength of both transmissions diminished with distance, thereby permitting combined aerial systems to be planned on a rational basis. The use of equal polarization for both transmissions would result in the design of a receiving aerial in one plane, but of compromised efficiency. The use of unequal polarization would result in the design of independent aerials in opposite planes, but with negligible mutual loss of efficiency. The problem was greatly complicated when separate siting was envisaged, because there would exist areas where the B.B.C. signal would be much stronger than the alternative signal, and others in which it would be much weaker or equal.

Each case would have to receive individual treatment, and one could readily visualize a simple indoor aerial for the reception of one programme and an elaborate multi-element system for the other. Separate feeding arrangements from each aerial might be essential if full flexibility was to be achieved.

Several other speakers took part in the discussion and there was general agreement that the industry should know the plans for impending alternative television programmes as soon as possible. The most urgent need was to know the polarization of the signal and the sites of the transmitters. One speaker went so far as to ask that test transmissions should be started in the near future.

The question of polarization was the subject of several remarks, but there was fairly wide agreement that horizontal polarization was preferable to vertical polarization, and it was felt that the impending alternative television programmes should be transmitted with horizontal polarization, an additional advantage being that the aerials were less unsightly than those used with vertical polarization.

The question of ghost images was raised, and it was thought quite possible that the Band I and Band III aerials would receive reflections from different obstacles, particularly in those cases where the two transmitters were differently sited. This might lead, one speaker felt, to rather complicated arrays of reflectors to eliminate these ghost images. It was thought that aircraft flutter might be less serious in Band III transmissions owing to the higher frequencies employed. The density of television transmissions would eventually lead to the same problems as were at present being experienced in the medium waveband, and a possible solution was the use of wire distribution for television broadcasts. The use of a standard intermediate frequency was thought to be a necessity if the conversion of existing equipments to receive alternative programmes was to be reasonably simple. A wide range of frequencies had been used over the past few years and to cover only 80 per cent of the receivers manufactured in that period one would require convertors to work on three different frequencies.

Ross-shire Hydro-Electric Scheme

A scheme to develop the water power resources of the River Orrin (Ross-shire), the Allt na Fainich, the Allt Goibhre, the Allt na Criche and their tributaries has been confirmed by the Secretary of State for Scotland (Mr. James Stuart). The scheme, prepared by the North of Scotland Hydro-Electric Board, provides for the creation of a new loch in Glen Orrin, five miles upstream from the Orrin Falls, by the construction of a dam across the River Orrin. Water from the loch will be taken by tunnel to a generating station with an installed capacity of 18,000 kW to be erected near Achonokie in Strathconon, on the southern shore of the loch which is at present being created at Torr Achilty as part of the Board's Glascarnoch, Luichart and Torr Achilty scheme. The water discharged from the generating station at Achonokie will thus eventually pass through the Torr Achilty generating station as well. The scheme is estimated to cost £4,550,000.

NEW ELECTRICAL EQUIPMENT

Marine Emergency Light

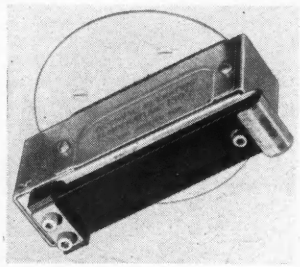
EMERGENCY lights, large numbers of which were supplied by the GENERAL ELECTRIC Co., LTD., Magnet House, Kingsway, London, W.C.2, to the Admiralty and Merchant Navy during the war, have now been re-introduced. They are intended for general marine use to meet the recommendations of the International Conference on Safety of Life at Sea, and for all applications requiring a battery operated light that can be brought into use in the event of a power failure.

G.E.C. emergency light

The equipment, which has been approved by the Ministry of Transport and certified by the Home Office for use in inflammable atmospheres, consists of a tubular lead-coated steel body containing the batteries, with an armour-glass dome at one end. Normally it is stowed downwards but when reversed an Archimedean gravity type switch automatically brings the light into action. The weight, with batteries, is 4 lb 6 oz and the burning life varies from 8 to 20 hours according to the type of cell used. The price complete with two 1½ V dry cells is £3 4s.

Fire Detector

A fire detector now being produced by GENT & Co., LTD., Faraday Works, Leicester, is based on a new principle of operation. Although a bi-metal strip is used, the strip itself does not operate the contacts. When the temperature reaches a predetermined level the bi-metal strip releases a catch which tilts a mercury tube, giving a definite, quick-action operation. The internal operating temperature is 150 deg F. The backplate is designed to fit standard B.S. boxes.



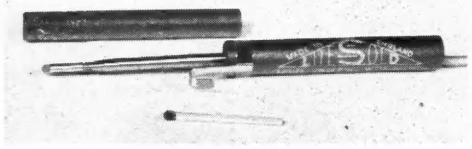
Gent fire detector

Lightweight Soldering Iron

Claimed to be the lightest soldering instrument so far produced, the "Litesold" iron now being placed on the market by LIGHT SOLDERING DEVELOPMENTS, LTD., 106, George Street, Croydon, weighs ½ oz and measures 6in long. It is fitted with a ⅛in bit, the loading is only 12 W, and heating time is approximately one minute. The fully insulated element is flash-tested during manufacture to 1 kV a.c. and it is considered quite satisfactory for radio or instrument work.

The iron is obtainable with either a fixed or replacement bit and is available for voltages ranging from 6 V to 250 V a.c. or d.c. In addition to the ⅛in diameter bit model, the instrument can also be supplied with 3/16in, ¼in and 5/16in bits, the respective loadings being 23, 27 and 40 W.

The price of the ⅛in "Litesold" is 19s 6d and with a replaceable bit it costs 2s extra. A slide-on cap is provided to protect the bit when not in use.



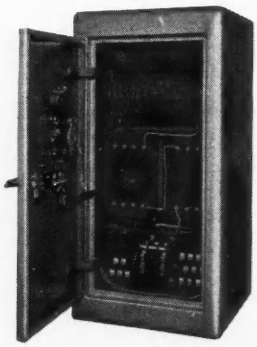
"Litesold" soldering instrument

Variable Speed Drive

The M.T.E. "Vari-drive" has been developed by M.T.E. CONTROL GEAR, LTD., Leigh-on-Sea, to cater for infinitely variable speed motor applications where a.c. supply only is available and where a wide range of speed is required. As it is not an electronic device, the disadvantage of a delay during the heating period is not encountered, the unit being ready for immediate service at all times.

The control component contains a specially designed electromagnetic system, based on the transductor technique. The output of the transductor is fed to metal rectifiers to give vernier speed control to the d.c. driving motor. The motor speed variation obtainable is 15–1 or greater if required, with constant torque characteristics. The components are simple and robust, requiring virtually no maintenance and no specialized knowledge to install and operate.

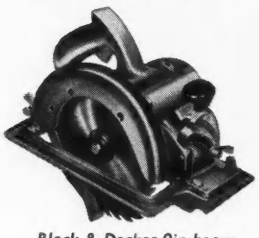
For a number of drives, such as conveyors and loaders, the system can be made fully automatic to regulate the rate of feed to suit the capacity or load conditions of a mill, pulverizer or similar machinery.



M.T.E. "Vari-drive" control equipment

Portable Electric Saw

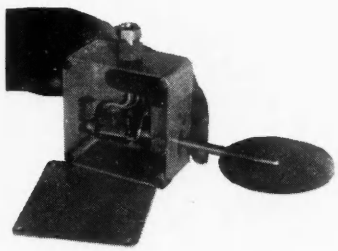
An addition to the range of electric saws manufactured by BLACK & DECKER, LTD., Harmondsworth, Middlesex, is a 9in high speed "one-hand" saw. This model includes a rip fence as a standard fitting and has helical gears; it can also be inverted and used as a saw bench. The maximum cutting depth is 3¼in and this can be regulated by means of front and rear adjustments. The bevel cutting angle enables cuts of any angle up to 45 deg to be made. A wide variety of blades allows not only timber but cast iron, brick, tile, asbestos, sheet metals, etc., to be cut. The weight of the machine is 15¾ lb and the price £32 10s.



Black & Decker 9in heavy duty electric saw

Air-Flow Switch

A simple device, needing no maintenance, for automatically shutting down plant and/or closing a warning circuit on failure of air flow has recently been placed on the market by BESSON & ROBINSON, LTD., 6, Government Buildings, Kidbrooke Park Road, London, S.E.3. One or more 1 A mercury switches at 250 V a.c. can be fitted, each arranged to make or break a circuit while air-flow persists. The arm pivots on a stainless steel shaft moving in special molybdenum lubri-



B. & R. air-flow switch type E.01

cated plastic bearings, and if left alone this bearing system is claimed to operate indefinitely. The vane measures 5in in diameter and projects 7in from the side of the box which measures 4in square by 2in deep. Provision can be made for one or more ¾in conduit entries or cable glands.

Soldering Gun

The Audion " Speed Iron " soldering gun, now available from the MARTIN AGENCY, 43, London Road, Kingston-on-Thames, has an air cooled transformer and operates on the same principle as the transformer welder. It is claimed to heat up within five seconds; the high heat produced at the tip of the iron is due to the high current (approximately 500 A) and the low voltage. The trigger switch is normally open when not in use, and when closed, being in the primary circuit, it causes the current to flow immediately in the soldering loop, which is connected across the secondary winding. Low in weight (2¾ lb) the unit is housed in a moulded, impact resisting case, and supplied with a dozen replacement tips. Suitable for use on a.c. only, two voltage ranges are available, 110 V and 200/240 V. Retail price is £4 10s.

Strip Light Fitting

Designed to provide small scale strip lighting in the home, the new " Lumenette " strip light fitting announced by SIEMENS ELECTRIC LAMPS & SUPPLIES, LTD., 38/39, Upper Thames Street, London, E.C.4, consists of a plastic holder incorporating a 35 W 12in architectural lamp. The fitting requires neither shade nor reflector because of low surface brightness. It may be operated in any position and is suitable for use in kitchens, halls, over mirrors, bed-heads, etc. The holder is available in cream or green and the complete unit retails at 23s 6d. Replacement lamps cost 12s 4d plus 2s 3d purchase tax in the United Kingdom.

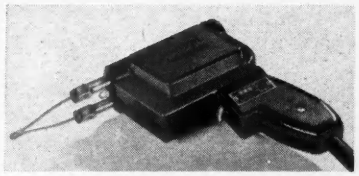
Paper Reel Clamp

A paper reel clamp suitable for fitting to its range of fork trucks has been introduced by CONVEYANCER FORK TRUCKS, LTD., Liverpool Road, Warrington. The clamp has two arms, one fixed and the other sliding on rollers in a channel frame. The sliding arm is moved by twin hydraulic jacks coupled in parallel and the complete unit can be fitted to the standard carriage bar of the truck. Paper reels between 24in and 42in in diameter can be handled.

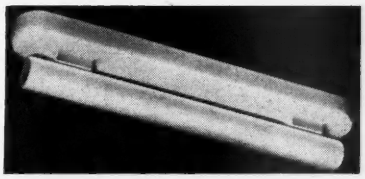
Bench Spot Welder

A small, high-speed, air-operated spot welder, suitable for mounting on a bench, is available from the METROPOLITAN-VICKERS ELECTRICAL CO., LTD., Trafford Park, Manchester, 17. It is capable of welding clean mild steel up to two pieces of 18-gauge on production, and two pieces of 16-gauge intermittently. Stainless steel up to two pieces of 22-gauge can also be welded.

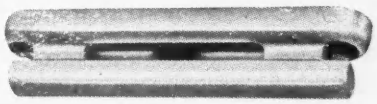
The operation is initiated by depressing a foot switch, single spot or stitch welding being obtained by momentary or continuous closure respectively. The AS10/9 has a loading of 10 kVA and a throat depth of 9in. The welding period is controlled by a neon timer operating in conjunction with a mechanical contactor. These are fitted in a bench or wall-mounting sheet steel case. An alternative round type bottom arm can be supplied. By fitting a top platen and a combined bottom arm and platen the machine can be converted into a projection welder particularly suitable for assemblies in the thinner gauges of mild steel.



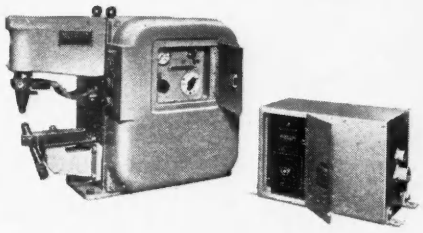
Audion " Speed Iron " soldering gun



" Mazda " architectural light tube fitting



Siemens " Lumenette " strip light fitting



Metrovick spot welder and neon timer

Stott's electrically heated deep fryer

Light Tube Fitting

A new and inexpensive fitting for use with a " Mazda " 12in 35 W architectural light tube has been introduced by the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2. Moulded in a plastic material, the fitting is easily installed by means of two wood screws, the heads of which are concealed from view when the lamp is in place. Clip sockets in the fitting grip the side mounted pegs on the lamp which plugs into position.

The fitting is supplied in either cream or pastel green, price 7s 6d plus 1s 3d purchase tax in the United Kingdom.

Deep Fryer

A new electrically heated deep fryer has recently been placed on the market by JAMES STOTT & CO. (ENGINEERS), LTD., Vernon Works, Oldham. The pan and hob are constructed of mild steel with all joints welded to form one piece, and the outer casing is of " Birmabright " having a polished finish. Special tubular sheathed immersion type heating elements suitable for operation in oil or fat are provided and the total loading of the appliance is 5·4 kW.

For easy cleaning the heaters are fitted on a hinged box and can be swung clear, giving full access to the base of the pan. In this position an automatic cut-out comes into operation, thus preventing switching on of the heaters. The temperature of the fat is automatically controlled by a " Satchwell " hydraulic thermostat having a temperature range of 150 to 400 deg F. Pilot lights indicate when the appliance is switched on and when the fat is at the desired temperature.

The overall dimensions are 20⅝in wide by 25¾in deep by 37¼in high and the internal size of the pan is 15in long by 13½in wide by 7in deep. Two baskets, constructed in iron wire and tinned after manufacture, are provided and these measure 11in long by 6¼in wide by 5in deep. The appliance can be supplied for operation on either a.c. or d.c.

PATENT OFFICE LIBRARY

Access to over 3,500 scientific and technical periodicals in all languages has been provided by a new extension to the Patent Office Library which is now open to the public in the basement of the headquarters building in Chancery Lane, London. Another important addition is the provision of a special section for bibliographies and abstracts. The Library has a total stock of 360,000 volumes.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (2s 8d each including postage) will be obtainable after 2nd June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

250. Jarret, J. M. B., and Jarret, J. H.—Conductor devices having a variable electric resistance. 4th January, 1950. (709902.)

14218. Cosmocord, Ltd., and Kelly, S.—Electromechanical transducers. 7th June, 1951. (709623.) 14964. Electromechanical pick-up devices. 15th June, 1951. (709624.)

16403. Petrolite Corporation, Ltd.—Electric treaters for emulsions. 30th June, 1950. (709626.)

18178. British Insulated Callender's Construction Co., Ltd., Soc. d'Exploitation des Etablissments Paindavoine Freres, and Hamilton, A. M.—Structural unit and structures built up from such units. 19th July, 1951. Cognate applications 18179, 20th July, 1950, 18180, 20th July, 1950, and 29635, 4th December, 1950. (709706.)

18558. Soc. d'Electronique et d'Automatisme.—Chains for counting electric impulses. 25th July, 1950. (709707.)

26644. Trigs, W. W. (Pierce Foundation, J. B.).—Electric plugs. 10th January, 1952. (709630.)

27844. Metropolitan-Vickers Electrical Co., Ltd.—Sealing glands for rotatable shafts. 6th November, 1951. (709805.)

28545. English Electric Co., Ltd.—High-frequency drying apparatus. 22nd November, 1951. (709631.)

29822. Electric & Musical Industries, Ltd.—Non-linear electrical circuits. 15th November, 1951. (709715.)

30122. General Electric Co., Ltd., Dovey, D. M., and Randle, K. C.—Electrical resistance heating elements. 10th December, 1951. (709806.)

30142. Siemens & Halske Akt.-Ges.—Electron tube with fluorescent screen, particularly a tuning indicator tube. 8th December, 1950. (709909.)

30590. Ferranti, Ltd.—Positional data transmitting systems. 10th December, 1951. (709910.)

31415. Mechanical Products, Inc.—Electric circuit breakers. 27th December, 1950. (709717.)

1951

182. English Electric Co., Ltd.—Flameproof housing assemblies. 1st January, 1952. (709719.)

545. Trico-Folberth, Ltd. — Electric switches. 8th January, 1952. Cognate application 15271, 27th June, 1951. (709917.)

583 & 5353. Ferranti, Ltd.—Indicating apparatus. 9th January and 9th May, 1952. (709918 & 709922.)

3785. Ferranti, Ltd.—Electric signal translating and recording devices. 15th February 1952. Cognate application 5700, 9th March, 1951. (709921.)

5608. Roneo, Ltd.—Method and apparatus for electrically producing copying stencils. 22nd February, 1952. (709809.)

8297. British Thomson-Houston Co., Ltd.—Process of forming fluorescent screens. 10th April, 1951. (709994.)

8626. Heinrich, D. O.—Discharge electrodes of electrostatic precipitators. 28th January, 1952. (709635.)

9291. Etablissements Merlin & Gerin, Soc. Anon.—Closing and tripping mechanisms for electric circuit breakers. 20th April, 1951. (709930.)

10568. Siemens & Halske Akt.-Ges.—Magnetically controlled electronic valves. 4th May, 1951. (709728.)

12904. Metropolitan-Vickers Electrical Co., Ltd.—Electric measuring circuit arrangements. 5th March, 1952. (709934.)

13532. British Thomson-Houston Co., Ltd.—Electric filament lamps with parabolic envelopes. 1st April, 1952. (709815.)

15498. Patent-Treuhand-Ges. für Elektrische Glühlampen.—Method of preventing the veiling of luminescent coatings in electric gaseous discharge lamps. 29th June, 1951. (709818.)

16757. Electric & Musical Industries, Ltd.—Deflecting circuit arrangements for cathode-ray tubes. 3rd July, 1952. (709939.)

16777. Bond, R., and Dickson, D. L.—Agitating apparatus for gas or electrically heated washing boilers. 30th June, 1952. (709744.)

18156. Anglo-Iranian Oil Co., Ltd., and MacLean, T. T.—Electric battery hand lamp for use in explosive atmospheres. 30th July, 1952. (709746.)

18647. Electric & Musical Industries, Ltd.—Mosaic target electrodes as are utilized in television pick-up tubes. 8th August, 1952. (709945.)

19224. Drysdale & Co., Ltd., and Young, J.—Combined electric motor and coupling. 28th July, 1952. (709946.)

19361. British Thomson-Houston Co., Ltd.—Automatic electric circuit breakers. 16th August, 1951. (709947.)

20188. Heemaf, N. V.—Electronic devices for selective operation of circuits. 27th August, 1951. (709649.)

20610. English Electric Co., Ltd.—Oil actuated protective relays for transformers and other oil-filled electrical apparatus. 29th August, 1952. (710004.)

21366. Standard Telephones & Cables, Ltd. (Lorenz Akt.-Ges., C.).—Deflection systems for cathode-ray tubes. 11th September, 1951. (709827.)

23472. British Thomson-Houston Co., Ltd.—Protective systems for electric motors. 9th October, 1951. (710007.)

24464. Metropolitan-Vickers Electrical Co., Ltd.—Combustion chambers for gas-turbine plant. 24th September, 1952. (709654.)

24914. Loewe Opta Akt.-Ges.—Method of producing insulating layers on electric heating resistances. 25th October, 1951. (709955.)

25514. Pertrix-Union Ges.—Electric current generators. 31st October, 1951. (710012.)

25828. British Thomson-Houston Co., Ltd.—Method of preparing luminescent materials. 5th November, 1951. (709831.)

26798. Littmann, R. — Electrodynamic sound receiving and transmitting apparatus. 15th November, 1951. (709656.)

27933. British Thomson-Houston Co., Ltd.—Ward-Leonard systems for winding engines. 25th November, 1952. (709835.)

28008. Westinghouse Brake & Signal Co., Ltd., and Tillotson, P.—Automatic train control systems. 7th November, 1952. (709836.)

28220. Automatic Telephone & Electric Co., Ltd.—Carrier current transmission systems. 10th November, 1952. (709758.)

29446. Armstrong Siddeley Motors, Ltd.—Electrical heating and mounting of axial flow compressor blades. 23rd October, 1952. (710019.)

1952

36. Philips Electrical Industries, Ltd.—Apparatus comprising means for concentrating beams of charged particles. 1st January, 1952. (709842.)

1029. Philips Electrical Industries, Ltd.—X-ray image amplifiers. 14th January, 1952. (709764.)

1147. British Thomson-Houston Co., Ltd.—Control systems for electric machines. 14th January, 1952. (709765.)

2442. Mechanical Products, Inc.—Electric circuit breakers. 29th January, 1952. (709767.)

4083. Ranco, Inc.—Electric switching mechanism for automatically controlling refrigerator unit defrosting cycles. 15th February, 1952. (709771.)

6163. British Thomson-Houston Co., Ltd.—Overload protecting systems. 10th March, 1952. (710025.)

6832. Philips Electrical Industries, Ltd.—Radio receiving circuits. 17th March, 1952. (709975.)

8326. Commissariat a l'Energie Atomique.—Low-current electronic amplifiers. 1st April, 1952. (709779.)

11436. Philips Electrical Industries, Ltd.—Adjustable coupling devices for high-frequency alternating voltages. 6th May, 1952. (709676.)

11746. Allmanna Svenska Elektriska Aktiebolaget.—Anode tube for a high voltage ionic valve. 9th May, 1952. (709783.)

15097. Aktiebolaget Bofors.—Electrically operated remote control systems. 16th June, 1952. (710042.)

15212. Standard Telephones & Cables, Ltd.—Diversity radio telegraph systems. 17th June, 1952. (709793.)

15854. Hoover, Ltd.—Hand irons. 24th June, 1952. (709795.)

16400. British Thomson-Houston Co., Ltd.—Manufacture of decorative electric incandescent lamps. 30th June, 1952. (709865.)

17567. Standard Telephones & Cables, Ltd.—Radio frequency amplitude control device. 11th July, 1952. (709799.)

19147. Philips Electrical Industries, Ltd.—High-frequency heating. 29th July, 1952. (709871.)

20251. Thomas & Betts Co.—Electrical clasp connector. 12th August, 1952. (709874.)

20526. General Motors Corporation.—Control switches for electric motors. 15th August, 1952. (709876.)

21645. General Electric Co.—Laundry drying machines. 28th August, 1952. (710054.)

23534. Standard Telephones & Cables, Ltd.—Attenuating arrangements for high frequency electromagnetic waves. 19th September, 1952. (709880.)

23991. Ray-O-Vac Co.—Electric primary batteries. 24th September, 1952. (709883.)

24060. General Electric Co.—Electric motor control systems. 25th September, 1952. (710059.)

24639. Landis & Gyr Akt.-Ges.—Electrometer. 1st October, 1952. (709885.)

26109. Siemens-Schuckertwerke Akt.-Ges.—Fire-resisting oil-filled electric cable installation. 17th October, 1952. (710062.)

27073. British Thomson-Houston Co., Ltd.—Silicon enamel pigments. 28th October, 1952. (710064.)

27840. Philips Electrical Industries, Ltd.—Multiplex signal transmission systems. 5th November, 1952. (709695.)

29799. Westinghouse Electric International Co.—Refrigeration apparatus. 25th November, 1952. (710066.)

30088. British Thomson-Houston Co., Ltd.—Apparatus for basing electric lamps. 27th November, 1952. (709896.)

Financial Section

STOCKS and SHARES

THE distraction of the Easter holiday did not prevent a lively display of strength by the gilt-edged market. This contrasted with a somewhat reactionary tendency among industrials, which (according to the share price indices) had just previously risen clear above all previous records. Buying of Government securities was again based, it is thought, on the expectation of another reduction in Bank Rate sooner or later. Industrials were apparently under the influence of profit-taking by holders persuaded that the extent of the past rise in prices limits, for the present, the scope for further advances. At bottom, however, confidence in the outlook held generally firm. The electrical equipment market had a number of interesting dividend declarations to consider. Publication of the customary table of electrical investments will be resumed next week.

Increased Dividends

C. A. Parsons £1 shares showed little further alteration, at 45s, after the declaration of a final dividend making a total for 1953 equivalent to 7½ per cent on the present capital. The latter was trebled during the period as a result of the share-for-share capital bonus and the cash offer of new shares, in the same proportion, at 22s 6d. Allowing for the bonus, the latest distribution represents an increase of 1¼ per cent. Net profits have been practically maintained despite a much larger tax charge. Chloride Electric £1 shares, which had risen very strongly in anticipation of the final dividend, came back 1s or so to 54s 6d after the announcement. On the basis of the present capital (also doubled during the year by a share bonus) the total distribution is being raised in effect by 2½ to 12½ per cent. Profits have expanded by about a half. Pressed Steel 5s shares were very firm at 16s 3d following the raising of the dividend to a total of 17½ per cent.

Cable Payments Maintained

In bringing the distribution for the year to a total of 10½ per cent, W. T. Henley's Telegraph are making effectively the same distribution as for the previous period. The preliminary profits statement records a sharp recovery in group profits, which rose by a third to £693,000 and cover the dividend payments some 2½ times over. In response to this, the price of the 10s shares was marked up to 18s 6d, making the yield nearly 5¾ per cent. Net earnings of Aberdare Cables for the latest period come out almost exactly as before, after a larger tax provision, and the 12½ per cent payment for the year represents the same distribution as the 25 per cent previously paid on half the capital now ranking. With the shares subsequently quoted at 8s 6d the return works out at 7·4 per cent.

Results for 1953

With the flow of annual company results now in full spate, the opportunity may again be taken to summarize those of some of the electrical engineering firms (or of companies with electrical associations) which have issued their full accounts within the past month or two:—

Company	Earned % 1952	Earned % 1953	Last Dividend %
A.E.I.	43	45	11¼
Bakelite	25	20	12½
Bulgin A.F.	51	53	30
Cable & Wireless ...	12	12	9
Clarke Chapman ...	91	85	20
Decca	123	92	35
Desoutter	53	61	20
English Electric ...	35	27	10
Ericsson	89	85	25
Hoover	52	106	45
Int. Combustion ...	44	43	20
R. A. Lister	19	20	12
Mather & Platt	53	62	15
Mid. Elec. Manufg. ...	65	57	15
Newman Ind.	10	12	10
A. Reyrolle	71	68	13⅜
Taylor Tunnicliff ...	47	45	12½
Telegraph Cond. ...	83	115	30
Wolf Elec.	55	51	17½

Earnings and Dividends

In the above table, the first two columns of figures express the net earnings of the past two years as a percentage (gross) of the ordinary capital. They represent, in other words, the rate of dividend which could have been paid (subject to profits tax) if the companies concerned had distributed up to the hilt the surplus of profits remaining after all charges, including income tax and the excess profits levy. Comparison between the figures for the last two years gives an impression of the extent to which net earnings (after tax) varied between the two periods. The difference between the latest earnings and the rate of dividend actually paid indicates, of course, the proportion of profits ploughed back into the business, and measures the conservatism of the dividend policy.

Conservative Distributions

Conservatism of dividends is a characteristic of the results summarized in the foregoing table. Twelve of the companies listed raised their ordinary payments in respect of the latest year, but in nearly half the cases the amount distributed is still covered three to four times by the available surplus. In the figures for earnings, adjustments have been made for capital bonuses distributed since last year, but not for issues of shares for cash. Results of English Electric and Reyrolle were among those affected by the latter factor. Expansion of profits during 1953 appears to have been of generally moderate proportions. The comparison would look a good deal more favourable on the basis of trading profits before deduction of taxation, which in several cases pruned severely a growth of earnings.

Vickers' Results

Vickers' proposal of a share-for-share capital bonus has served partly to offset whatever disappointment may have been felt over the absence of a change in the dividend rate, or (to any material extent) in the net group profit for 1953. After rising to over £3 in advance of the news, the shares were subsequently quoted at 58s 3d. With the dividend deducted from the price, the yield works out at 5¼ per cent, and the distribution is calculated to be covered thrice by the net surplus of earnings. No mention is made yet of any decision on the question of repurchasing the formerly nationalized steel interests. Meanwhile, the original compensation of £12½ million Treasury stock has been reduced to the extent of £7 million, a net loss of £668,000 being realized on the sale.

Telegraph Condenser

A leap of 15s in the price of Telegraph Condenser 10s shares, to £3, enlivened the market in electrical shares during the week before the holiday. It followed the declaration of a final distribution making 30 per cent for the year, and of a proposed 100 per cent capital bonus. Not only is the payment 10 per cent more than last year's, but it applies to capital increased since then by a 20 per cent share bonus. Other share distributions had been made in the two preceding years, the rate of dividend being kept unchanged each time at 20 per cent. As a result, the holder of shares at the start of this period will now already have double the original number, and be receiving a larger return per share. Yield on the shares is at present 5 per cent.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 30th April:—

GLYNDOVA. No. 722,736, Class 7. Sawing machines, woodworking machines, cranes, winches, pumps included in Class 7, presses (machines), electric motors (not for land vehicles), dynamos, boilers (parts of machines), etc.—Glyndova, Ltd., 45–47, George Street, London, W.1.

CHROMOLAC. No. 724,248, Class 9. Chromium containing electrodes for use in electric welding.—Rockweld, Ltd., Commerce Way, Croydon, Surrey.

OPALAX. No. 725,751, Class 9. Scientific, nautical, surveying and electrical apparatus and instruments, radio sets (sold complete), etc., and parts, but not including electric lamps or electric batteries or any goods of the same description.—Crayonne, Ltd., St. Bernard Works, Bexley, Kent.

CREDA STAR. No. 726,933, Class 11. Electric cooking stoves.—Simplex Electric Co., Ltd., Broadwell, Oldbury, near Birmingham.

BLENDOLITE. No. 727,180. EDILUX. No. 727,181, Class 11. All goods included in Class 11.—Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.

REPORTS and DIVIDENDS

The Telegraph Condenser Co., Ltd.—The accounts for 1953 show a trading profit of £460,897, as compared with £508,216 for the preceding year, to which is added interest and dividends of £7,913, making £468,810. After meeting all charges, including £204,889 for taxation, it is proposed to pay a final dividend of 15 per cent (same), plus a cash bonus of 10 per cent (nil), making 30 per cent for the year (against 20 per cent on smaller capital). The balance carried forward is £92,782 (against £83,503 brought in).

It is proposed to increase the capital to £880,000 by the capitalization of £300,000 of the general reserve and to distribute 600,000 fully paid ordinary shares of 10s each in the proportion of one new share for each ordinary share held.

In his statement circulated with the report and accounts, Mr. P. V. Hunter (chairman) says that during the latter part of 1953 and up to the present time both the factories have been working to capacity, due to renewed demand for the enormous range of fixed electrical capacitors in which the company specializes. If the present rate of incoming orders is maintained they can look forward to another busy year. Turnover was slightly lower in 1953 than the record figure reached in 1952, but output was somewhat higher, fierce competition forcing down the selling prices of many products. Export turnover was well maintained, and they achieved a marked increase in sales in hard currency countries. Increased competition may, however, lead to some reduction in export business in 1954. The order book has improved in recent months and was well spread over the company's products.

W. Canning & Co., Ltd., report a net profit for 1953 of £190,054 (against £181,534 for 1952), after providing £266,534 for taxation. General reserve receives £50,000 and £60,000 is contributed to the directors' and staff pension fund. It is proposed to pay a final dividend of 30 per cent (against 25 per cent), making 40 per cent for the year (35 per cent).

Permission has been received from the Capital Issues Committee to proceed with the capitalization of reserves, and an extraordinary meeting will be convened in due course at which resolutions will be submitted to increase the authorized capital to £1,200,000 and to issue, by way of capitalization of reserves, 1,200,000 fully paid ordinary stock units of 5s each in the proportion of one new unit for each ordinary stock unit held.

Thomas Bolton & Sons, Ltd.—The annual general meeting was held on 14th April. In his circulated statement Mr. P. V. Hunter (chairman) said that the deterioration in orders continued until nearly the end of 1953 when slight signs of improvement appeared. As a result of this shortage of orders in several of the most important sections of their business the output from these sections was seriously down. It was inevitable that after fourteen years of Government control of copper the industry should experience a disturbance of trade during the transition period consequent upon the return of copper to a free market. Other sections of the business had produced satisfactory profits.

The Chloride Electrical Storage Co., Ltd., in a preliminary statement, reports that the net surplus for 1953, after deducting £1,448,659 for taxation, is £968,022, as compared with £653,656 for 1952. To this are added profits relating to previous years of £221,690, a realized capital profit of £9,183, a transfer from specific reserves of £676,500 and £651,625 brought in. A sum of £1,071,252 is transferred to specific reserves, and profits retained by subsidiaries total £319,728, leaving an available balance of £1,136,040 (£1,121,643). It is proposed to pay a final dividend of 10 per cent on the "A" and "B" ordinary capital on capital increased by a 100 per cent scrip issue. An interim dividend of 5 per cent was paid on the smaller capital. The total distribution for 1952 was 20 per cent.

W. T. Henley's Telegraph Works Co., Ltd.—The group profit for 1953, subject to audit, after meeting all charges, including £578,699 for taxation, is £692,760, as compared with £522,398 for 1952. Reserves receive £440,000 and it is proposed to pay a final ordinary dividend of 8 per cent, making 10½ per cent for the year. This compares with 13 per cent for 1952, when the interim dividend of 5 per cent was paid before the 100 per cent scrip issue.

C. A. Parsons & Co., Ltd., report that after providing £1,560,000 for taxation, and £30,000 for contingencies provision, the net profit for 1953 is lower at £807,862, as against £814,598 for the preceding year. It is proposed to pay a final ordinary dividend of 4⅜ per cent on the £3·6 million capital as increased by a 100 per cent scrip issue, and by a 100 per cent rights issue. The interim dividend on the smaller capital was 6¼ per cent. For 1952 the total distribution on £1·2 million capital was 12½ per cent.

Aberdare Cables (Holdings), Ltd., reports a net profit for the year ended 31st October last of £162,500, as compared with £162,514 for the previous year. The final dividend is 7½ per cent, making 12½ per cent for the year on doubled capital, equivalent to the 25 per cent paid in 1951–52 on the old capital.

The Pressed Steel Co., Ltd.—The preliminary statement for 1953 shows that after meeting all charges, including £2,121,962 for taxation, the net profit is £802,849 (against £804,548 for 1952). It is proposed to pay a final dividend of 12½ per cent, making 17½ per cent on £3,314,444 capital as increased by a 100 per cent scrip issue. For the previous year the dividend was 20 per cent on the old capital.

The Ozonair Engineering Co., Ltd., reports a trading profit for 1953 of £24,985, as compared with £20,811 for 1952. After meeting all charges, including £11,785 for taxation, there is a net profit of £2,913 (against £2,128). It is proposed to pay an ordinary dividend for the year of 8⅓ per cent (same), plus a bonus of 2⅔ per cent (against 1⅔ per cent). After placing £1,000 to general reserve, the balance carried forward is £4,619 (against £4,219 brought in).

Matthew Hall & Co., Ltd.—A group net profit of £53,202 is shown in the accounts for 1953, as compared with £45,412 for 1952. It is proposed to pay a dividend for the year of 22½ per cent (against 20 per cent).

Brook Motors, Ltd., has declared an interim dividend of 5 per cent (unchanged) on increased capital.

The Calcutta Tramways Co., Ltd., has declared an interim dividend of 2½ per cent tax free (unchanged).

Contactor Switchgear, Ltd., made public in December last, has announced an interim dividend of 7½ per cent.

Parmiter, Hope & Sugden, Ltd., have declared an interim dividend on the ordinary stock of 7½ per cent (unchanged).

Bankruptcies

H. B. Campbell, 2170, Coventry Road, Sheldon, Birmingham, lately carrying on business as "Electronic Trade Services," at the same address and at 227a, Golden Hillock Road, Small Heath, Birmingham and at 2–4, Little Peter Street, Manchester.—Trustee, Mr. R. K. Clark, Somerset House, 37, Temple Street, Birmingham, 2, Official Receiver, released 2nd April.

S. A. Cooper, 17, St. Margaret's Road, St. Marychurch, Torquay, electrical engineer.—Trustee, Mr. G. W. Sisman, 26, Baldwin Street, Bristol, 1, Official Receiver, released 31st March.

J. A. Waghorn, 10, Sangora Road, London, S.W.11, lately carrying on business at 91, Eccles Road, S.W.1, electrical engineer and contractor.—Trustee, Mr. A. E. Attwood, 20–21, Lawrence Lane, Cheapside, London, E.C.2, released 23rd March.

L. A. L. Leech, 367, Wherstead Road, Ipswich, lately carrying on business under the style of T.L. Installation Co. (Norfolk and Suffolk), at 129a, Fore Street, Ipswich, contractor and electrical engineer.—Last day for receiving proofs for dividend 27th April. Trustee, Mr. C. A. Taylor, 3–5, Northgate Street, Ipswich, Official Receiver.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Belfast.—7th May. Electricity Department. Primary current injection testing set. (See this issue.)

Blackpool.—15th May. Corporation. Street lighting equipment. (See this issue.)

Bury.—1st May. Corporation. Street lighting equipment. (See this issue.)

Castle Eden (Co. Durham).—30th April. Peterlee Development Corporation, Shotton Hall. 76 fluorescent street lamps at Acre Rigg. Corporation's chief engineer.

26th May. Electrical installations in 144 houses at Acre Rigg. A. V. Williams, general manager.

Egypt.—CAIRO.—18th May. Cairo Electricity and Gas Administration. Switchgear. (E.S.B. 9754/54. Ten/8969.)*

Halifax.—15th May. Corporation. Street lighting equipment and paint. (See this issue.)

India.—BOMBAY.—20th May. Bombay Electric Supply and Transport Undertaking. 22 kV, 6·6 kV and 660 V cables and accessories. (E.S.B. 9524/54. Ten/8953.)*

Middlesbrough.—5th May. Borough Council. Electric lamps and unit dry cells for one year from 1st July. Borough engineer, Municipal Buildings.

Pakistan. — KARACHI. — 28th April. Director General, Posts and Telegraphs. Equipment for 600/1,000 line satellite exchange. (E.S.B. 9466/54. Ten/8944.)*

Portuguese East Africa.—LOURENCO MARQUES.—30th April. Directorate of Port, Railway and Transport Services, Mozambique. Electrical materials for foundry shop, including cables, lamps, switches, etc. (E.S.B. 8424/54. Ten/8959.)* 3rd May. Electrical materials (E.S.B. 9355/54. Ten/8975.)*

Ripon and Pateley Bridge.—27th April. R.D.C. Submersible pump, complete with motors and switchgear, for the Summerbridge water supply scheme. Silcock & Simpson, engineers, 10, Park Row, Leeds, 1.

Salford.—15th May. Corporation. Electric lamps and cables. (See this issue.)

South Africa. PRETORIA.—6th May. Union Tender and Supplies Board. Radio testing kits. (E.S.B. 9472/54. Ten/8926.)*

JOHANNESBURG. — 12th May. Stores Department, South African Railways. Telephone material. (E.S.B. 9432/54. Ten/8918.)*

Turkey.—ANKARA.—27th May. Iller Bank. Erection of a hydro-electric plant at Yozgat-Karanlikdere. (E.S.B. 9598/54. Ten/8957.)*

United States.—SEATTLE, WASHINGTON.—27th April. Corps of Engineers. Insulated wire and cable. (E.S.B. 8641/54. Ten/8837.)*

DENVER, COLORADO.—13th May. Department of the Interior, Bureau of Reclamation. Supervisory control and telemetering equipment. (E.S.B. 9608/54. Ten/8940.)*

6th May. 140,000 h.p. hydraulic turbine for the Skagit Project, Ross powerhouse. (E.S.B. 9625/54. Ten/8952.)*

Walsall.—15th May. Borough Welfare Committee. Electrical equipment required for the Fred Evans Home, Princes Avenue. R. E. Goakes, chief welfare officer, 29, Leicester Street.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Glasgow.—Corporation. Installation of washing machines, hydro-extractors and laundry machines, etc., in the new Baths and Wash-houses establishment at Paisley Road and Paterson Street, Kingston (£30,473).—Watson, Laidlaw & Co.

Lanarkshire.—County Council. Electrical installation, Protestant Primary School, Motherwell (£3,749).—E. J. Steel & Co., Ltd. Electrical installation, Catholic Primary School, Bellshill (£2,863).—Campbell Douglas & Co., Ltd.

Manchester. — Housing Committee. Electrical installation work in 269 houses on the Langley estate.—Marlow Electrical Co.

Mitcham. — Corporation. Recommended. Street lighting improvements, London Road and Upper Green East (£3,557).—Revo.

Rowley Regis.—Corporation. Recommended. Electrical installations in 64 houses at the Brickhouse Farm estate (£1,185).—Harvey's Electrical Service.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Basford.—Houses (155); J. J. Ellis, R.D.C. surveyor, Rock House, Stockhill Lane, Basford, Nottingham.

Birmingham. — Building work at mental hospitals (£90,000) and reconstruction of theatre suites at the Birmingham Accident Hospital (£110,000); Regional Hospital Board, 10, Augustus Road, Edgbaston, Birmingham, 15.

Brentford.—Offices (£70,000); Lucozade, Ltd., manufacturing chemists, Great West Road.

Bristol.—Home for elderly people at Horfield; J. N. Meredith, city architect, Colston Avenue, 1.

Additional classroom accommodation, Merrywood Grammar School; B. Wakefield & Son, architects, 18, Orchard Street.

Buckingham.—Houses (20); J. H. Cox, architect, 21, High Street, Aylesbury.

Carlisle.—Sixteen old people's houses at Upperby; city engineer, 18, Fisher Street, Carlisle.

Cheltenham.—Ten shops and 12 maisonnettes, Lynworth estate; G. Gould Marsland, borough surveyor, Promenade Offices.

Coventry.—Development of site in Tower Street; Bed & Mattress Co., West Orchard.

Crawley.—Factory and offices; William Sugg & Co., Ltd., gas engineers, etc., Vincent Works, Regency Street, London, S.W.1.

Factory; Treefus & Co., Ltd., 32, Holborn Viaduct, London, E.C.1.

Dagenham.—Factory, Hainault estate; Fletcher, Brock & Co., Ltd., 434, Ley Street, Ilford.

Darlington.—Office block at Four Riggs for C. M. Varley & Co., Ltd.; H. B. Richardson, architect, 3, Skinnergate, Darlington.

Extensions to St. Mary's and Queen Elizabeth Grammar Schools; borough architect.

Doncaster.—Development of site on the Wheatley Industrial Estate; L. C. Carpenter, Ltd., haulage contractors, 20, Scot Lane.

Ambulance station, Green House site (£25,984); Corporation Works Department.

Boys' school, Wheatley (£70,910); borough architect.

Edmonton.—Dwellings (137), Flamstead End estate; borough architect.

Eston.—Licensed premises at Skippers Lane for Vaux and Associated Breweries Ltd. (£16,000); Kitching & Co., architects, 21, Albert Road, Middlesbrough.

Fleet (Hants).—Six shops and twelve flats, High Street; R. Holford & Co., Ltd., Walnut Tree Close, Guildford.

Grimsby.—Houses (225), Grange and Crowland estates; J. V. Oldfield, borough surveyor, Municipal Offices, Town Hall Square.

Guildford.—Houses (120), The Rough; J. W. Wilton, R.D.C. surveyor, Millmead House.

Harlow.—Factory; Greaves & Thomas, Ltd., 103, Northwold Road, London, N.5.

Hatfield. — Houses (108), Lemsford Road area; R.D.C. surveyor, 16, St. Albans Road.

Ilkeston.—Houses (100), Kirk Hallam estate; Rick & Beck, Ltd., builders, Nottingham Road, Attenborough.

London.—STREATHAM.—Hostel for the Philippa Fawcett Training College, Leigham Court Road; C. H. Gibson, Ltd., builders, 509, London Road, Thornton Heath.

WANDSWORTH.—Nine shops and 18 flats, St. Alphonsus Road; borough engineer.

Newbury.—Houses (42), Kiln Road, Shaw; F. J. Reynolds, Ltd., builders, Thatcham.

Newcastle-on-Tyne.—Additions to Workington, Ashington and St. George's Mental Hospitals, new accident hospital at Middlesbrough and additions to Newcastle General Hospital for Newcastle Hospital Board, Osborne Road, Newcastle; P. H. Knighton, chief architect.

Additions, Wingrove Road, for Vaux and Associated Breweries; M. A. Mackenzie, architect, 1, Eldon Square, Newcastle-on-Tyne.

Offices, Bath Lane, for John Sinclair, Ltd.; J. W. Taylor & Son, architects, St. James' Buildings, Gallowgate, Newcastle.

Houses (154), Fawdon Lane; city architect, 18, Cloth Market.

Offices, Ouse Street, for R. Rankin & Sons, Ltd.; H. Gatoff, architect, 51, Grainger Street.

North Riding.—Infant welfare centre at Guisborough; H. J. Knowles, county architect, County Hall, Northallerton.

North Shields.—Factory additions for Microwave, Ltd.; R. Jordan, builder, Queen Alexandra Road, North Shields.

Factory additions for Torday, Ltd.; D. & J. Ranken, Ltd., builders, Stockton Road, Sunderland.

Northumberland. — Infants' school and modern school at Bedlington (£200,000); county architect, County Hall, Newcastle-on-Tyne.

Norwich.—Houses (253), Heartsease estate; city architect, City Hall.

Peterborough.—Office block, Town Bridge; Mitchell Engineering, Ltd., Fengate House, Fengate Road.

Second instalment of Dogsthorpe North Secondary School (£82,350); Peterborough Joint Education Board, Town Hall' Peterborough.

Peterlee (Co. Durham). — Houses (310), Acre Rigg, for Peterlee Development Corporation, Shotton Hall, Castle Eden; W. J. Scott, chief architect.

Junior and primary schools; G. R. Clayton, county architect, Court Lane, Durham.

Plymouth.—Showrooms and offices; F. D. Newcombe & Co., Ltd., 31, King Street.

Ramsey.—Houses (30), Westfield; Lea, Milner & Wardley, Huntingdon.

Redditch.—Extensions to library for U.D.C. (£15,851); Edgar Crowder, Ltd., South Road, Birmingham.

Rotherham.—Erection of Thryberg Secondary Modern School; J. Gerrard & Sons, Ltd., Swinton, nr. Manchester.

St. Paul's Cray.—Flats, Main Road, for Chislehurst & Sidcup U.D.C.; T. W. Fagg, clerk, Council Offices, Sidcup Place, Sidcup.

Salford.—Extensions at Ordsall Dyeworks for J. Worral, Ltd.; H. Pickles, architect, Halifax.

Salisbury.—Services Club (£150,000), New Street; Navy, Army & Air Force Institutes, Ruxley Towers, Claygate.

Saltford (Somerset). — Adaptations and conversions at Saltford House to form nurses' home; D. B. Cooper, group secretary, North East Somerset Hospital Management Committee, Keynsham Hospital, Keynsham, Bristol.

Scunthorpe.—Municipal offices as first portion of scheme for civic centre at Kingsway corner site; C. Cooper, borough surveyor, Comforts Avenue.

Stalybridge.—Bus garage and workshops at Tame Street for S.H.M.D. Transport Board; Howard & Benson, architects, 88, Mosley Street, Manchester.

Stamford.—Houses (95), Drift Road; Lenton & Partners, architects, 16, Broad Street.

Swansea. — Rebuilding St. Mary's Church; Sir Percy Thomas & Son, architects, 10, Cathedral Road, Cardiff.

Showroom and warehouse, Kingsway; J. Hall (Tools), Ltd., 80, The Kingsway.

Tipton.—Dwellings (86), Coneygree Road; borough surveyor.

Tiverton. — Houses (40), Wilcombe estate; borough surveyor.

Trowbridge. — Licensed premises, Studley Green estate; Ushers Wiltshire Brewery, Ltd., The Parade.

Wallsend.—Houses (132), Low Willington Farm estate; borough engineer.

West Riding. — Children's homes, Scawthorpe estate, Bentley, and on the Woodlands estate, near Doncaster; county architect, County Offices, Westfield Road, Wakefield.

Willington Quay.—Prefabricating shop for Cleland's (Successors), Ltd., shipbuilders and repairers; J. G. Thompson & Son, 28, Fowler Street, South Shields.

Windsor.—Houses (56), Straight Road; Taylor Woodrow (Homes), Ltd., Taywood Road, Greenford.

Worcester.—Development of estate at Warndon to provide over 1,000 dwellings; city engineer, 22, Bridge Street.

Worthing.—Final stage of Vale County Primary School; education architect, Town Hall.

York.—Houses (184), Chapel Fields site (£221,670); Sorrell (York), Ltd., builders, Hildreth House, Heworth, York.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E 1, to ascertain that proposed dates for their functions do not clash with others already arranged

Sunday, 25th April, to Tuesday, 27th April

SWANAGE.—Hotel Grosvenor. Association of Electrical Machinery Trades. Annual Convention.

Monday, 26th April

BIRMINGHAM.—James Watt Institute, Great Charles Street, 6 p.m. I.E.E. South Midland Radio Group. "The Theory and Application of Transistors," by F. F. Roberts and H. G. Bassett.

LEICESTER.—E.M.E.B., Charles Street, 7.30 p.m. I.E.S. Leicester Centre. "Lighting in the Textile Industry," by J. W. Howell.

LIVERPOOL.—Radiant House, Bold Street, 7.15 p.m. Incorporated Plant Engineers, Merseyside and North Wales Branch. Chairman's address.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Radio Section. "The Experimental Synthesis of Speech," by W. Lawrence.

NEWCASTLE-UPON-TYNE.—King's College, 6.30 p.m. Institute of Fuel, North-Eastern Section. Annual general meeting, preceded by afternoon visit to Consett Iron Co.

Tuesday, 27th April

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Measurements Section. "Auto-Self-Excited Transductors and Push-Pull Circuit Theory," by A. G. Milnes and T. S. Law. "Composite Cores for Instrument Transductors," by Dr. E. H. Frost-Smith and A. E. De Barr.

Manson House, Portland Place, 7 p.m. Society of Instrument Technology. "Instruments for Testing and Control in the Textile Industry," by S. L. Anderson.

WOLVERHAMPTON.—Staffordshire Technical College, Wulfruna Street, 7.15 p.m. British Institution of Radio Engineers, West Midlands Section. "Radio Telephone Equipment," by T. C. Howell.

Wednesday, 28th April

COVENTRY.—At the G.E.C. Telephone Works, 7 p.m. I.E.E. South Midland Students' Section. "Some Observations on the Use of Soft Magnetic Materials," by D. J. Storey.

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. "Aluminium Sheathed Cables," by P. M. Hollingsworth and P. A. Raine.

MANCHESTER.—Engineers' Club, Albert Square, 2 p.m. Institute of Fuel, North-Western Section. Annual general meeting to be followed at 2.30 p.m. by "Energy in the Future," by Dr. J. Bronowski. (Members' luncheon at 1 p.m.)

Engineers' Club, Albert Square, 6.45 p.m. Women's Engineering Society, Manchester Branch. "Some Aspects of Marine Propulsion," by F. A. Fawcett.

Thursday, 29th April

LEEDS.—Hotel Metropole, King Street, 7 p.m. Leeds Association of Engineers. Annual general meeting and presidential address by H. C. Newell.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers, Kelvin Lecture: "The Physics of the Ionosphere," by J. A. Ratcliffe.

Friday, 30th April

BIRMINGHAM.—Imperial Hotel, 7.30 p.m. Incorporated Plant Engineers, Birmingham Branch. "Welding" by F. A. Thomas.

LONDON.—Connaught Rooms, Great Queen Street, W.C.2, 12.15 for 1 p.m. British Electrical and Allied Industries Research Association. Annual luncheon.

Connaught Rooms, 6.15 for 6.45 p.m. Junior Institution of Engineers. Annual dinner.

Holborn Restaurant, 6 for 7 p.m. Edmundsons Group Reunion.

Saturday, 1st May

HARWELL.—I.E.E. Supply Section. Visit to the Atomic Energy Research Establishment.

LONDON.—I.E.E. London Students' Section. Visit to St. Paul's Control Centre, British Electricity Authority, at 10 a.m.

I.E.E. SUMMER MEETINGS

The revised programme of the Summer Meeting of the Institution of Electrical Engineers, which will be held in the Western Centre from 28th June to 2nd July, is a varied one, and in addition to a visit to Portishead "B" power station, includes visits to a number of works in the area and excursions. Evening functions have also been arranged.

The Summer Meeting of the Western Centre will be held at Llanwrtyd Wells from 21st to 24th May. The programme will include dancing, table tennis, golf, fishing and boating.